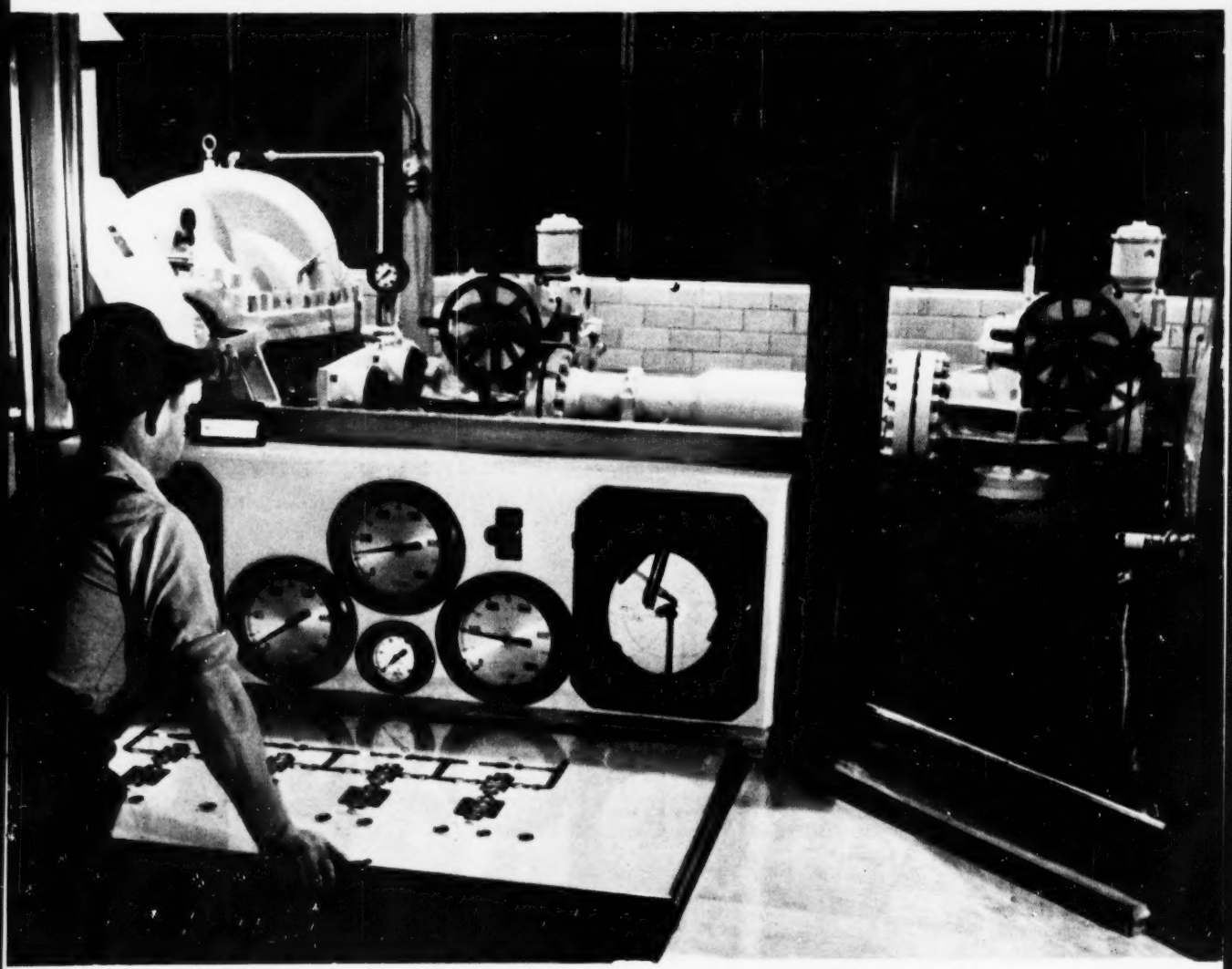
Instruments

THE MAGAZINE OF
MEASUREMENT · ANALYSIS · COMPUTING
INSPECTION · TESTING · CONTROL



Control room of compressor station at Midland, Texas. *(Courtesy, Rockwell Manufacturing Company)*

Including the
JOURNAL OF THE INSTRUMENT SOCIETY OF AMERICA (Page 573)

and the
JOURNAL OF THE SOUTHERN CALIFORNIA METER ASSOCIATION (Page 583)

Vol. 26 No. 4
APRIL • 1953

FISHER® WIZARD CONTROLLERS

YOU'LL ALWAYS SEE THEM WHERE RELIABILITY COUNTS AND DEPENDABILITY IS A MUST

The ingenious, simply-designed mechanism of Fisher Wizard Controllers provides extreme accuracy and dependability in pressure control.

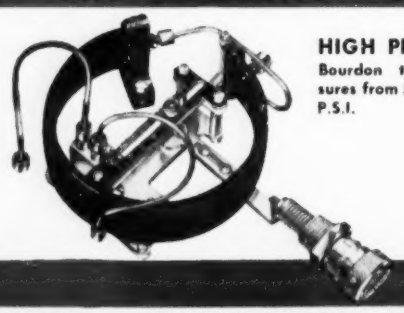
Fisher Wizard Controllers will completely solve your pressure control problems. They are individually built to meet your exact operating conditions, and are guaranteed to give satisfactory performance.

High pressure Fisher Wizards are available in throttling and snap acting types. Bourdon Tube pressures from 5 to 10,000 P.S.I. Diaphragm or remote panel mounting.

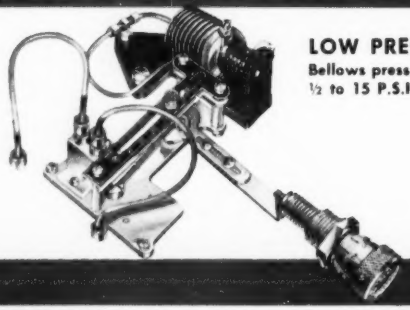
Low pressure Fisher Wizards available in diaphragm or remote panel mounting. Bellows pressures from ½ to 15 P.S.I.

FISHER LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE CONTROL

THE "BRAINS" OF WIZARD CONTROLLERS



HIGH PRESSURE
Bourdon tube pressures from 5 to 10,000 P.S.I.



LOW PRESSURE
Bellows pressure from ½ to 15 P.S.I.

FISHER GOVERNOR COMPANY Marshalltown, Iowa

what's new at BRISTOL...

SERIES 536 INDICATING

Free-Vane® Electronic Pyrometer Controllers

A new development in automatic temperature control

featuring...

● **A UNIQUE ELECTRONIC CONTROL SYSTEM, which gives a new quality of automatic control.** The controller is extremely stable, rugged, and sensitive. Very minute changes in the measured quantity at the control point (less than 0.003" on the scale) closes or opens the Thyratron-operated relay with positive trigger action, making it impossible for the relay to flutter or chatter. Control action is unaffected by changes in ambient temperature, line voltage, or wide variations in tube characteristics.

● **A NEW MILLIVOLTMETER MECHANISM for greater accuracy.** High-torque, rugged, jeweled mechanism has 30 ohm coil—Alnico 5 magnet—and a sensitivity of 15 ohms per volt. All ranges are critically or over damped.

● **OUTSTANDING MECHANICAL DESIGN for easy installation, interchangeability, and simplified servicing.** All units, including pyrometer unit, electronic control unit, and proportional-input unit are separate. The electronic control and proportional-input units plug in. No routine adjusting or attention needed. Series 536 Indicating Free-Vane Electronic Pyrometer Controllers are available as thermocouple and radiation pyrometers in ranges up to 4000° F. for L, H, LH, LOH, and LNH control and for L and H with proportional input control. Write for Bulletin P1248. The Bristol Company, 113 Bristol Road, Waterbury 20, Connecticut. 3.10

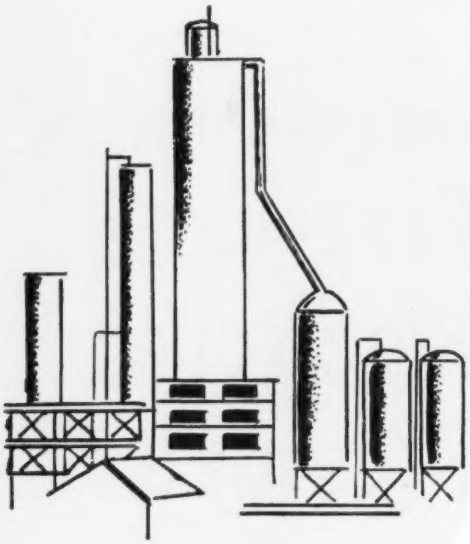
LOOK FOR OUTSTANDING NEW DEVELOPMENTS FROM BRISTOL

BRISTOL

THE DEPENDABLE GUIDEPOST OF INDUSTRY

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

What makes AMERICAN INDUSTRY succeed?

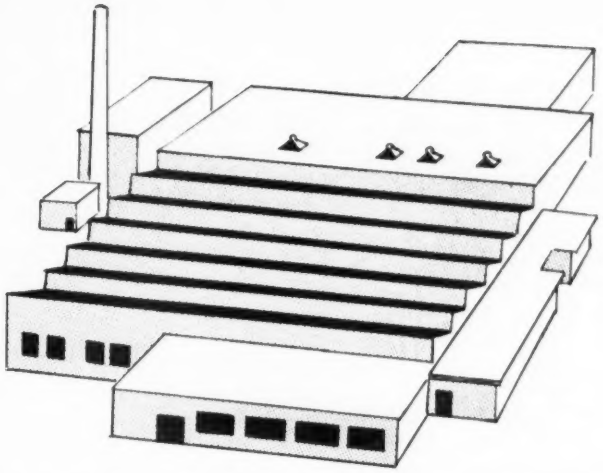


Today's organization!

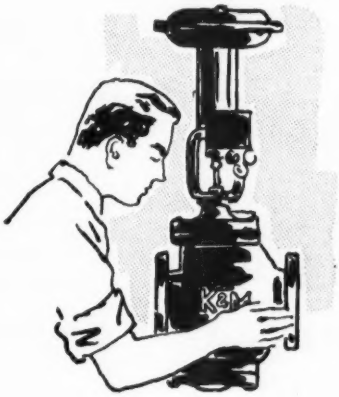
American industrial success is typically illustrated in terms of the development of vast raw material sources and in the magic numbers of fabrication. Between the head and the feet of the American industrial Goliath lies the Petro-Chem Process Industry, and without IT the rest becomes as useless as dismembered limbs.

The flow from raw material to manufactured product is often through Kieley and Mueller valves. Our ability to overcome the problems of distribution and distance and sustained customer service of our more than 4,000 customers from coast to coast is only possible with our large group of sales engineers in the field.

planning for tomorrow!



Increased production schedules can only be met by advance planning. For some time now the pressure has been on us to produce more with shorter delivery schedules. Our new plant, new equipment, and certain essential re-tooling has prepared us not only for present demand but for foreseeable future increased production.



Kieley and Mueller new plant facilities at Middletown, New York provide increased manufacturing space. The new buildings also house an ultra modern engineering and testing laboratory. Additional stock and storage space helps to speed completed orders, and new equipment adds to output capacity.

Our new catalog — covering the full range of Kieley and Mueller Control Valves for modern process requirements—will be mailed on your request.

K&M

KIELEY & MUELLER, INC.

Valve Makers Since 1879

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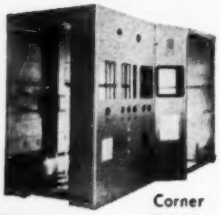
Quality is assured with
FALSTROM

INSTRUMENT PANELS
and CONTROL BOARDS

Benchboard Console



Five Section Cubicle Control Board and Lighting Canopy

Corner Cubicle Section

Refinery Cubicle with Mimic Flow Diagram in Color

Superior Engineering MAKES
FALSTROM YOUR LOGICAL CHOICE!

Experienced designing and quality fabrication assure the efficiency of any indicating, recording, or control installation. Whether you are planning new construction, modernizing existing installations or adding to present equipment, FALSTROM offers long years of experience and the most modern facilities for fabricating to your specifications or recommending standard designs. In any case, by specifying FALSTROM you specify the highest possible quality metal working techniques known to the industry. Estimates on your needs will be supplied promptly—call or write FALSTROM to arrange a consultation.

WRITE FOR BULLETIN #125

SINCE 1870 FALSTROM COMPANY
92 Falstrom Court, Passaic, New Jersey
DESIGNERS, ENGINEERS AND BUILDERS OF CUSTOM METAL PRODUCTS FOR INDUSTRY

Instruments
THE MAGAZINE OF MEASUREMENT INSPECTION · TESTING · CONTROL

Vol. 26 APRIL, 1953 No. 4

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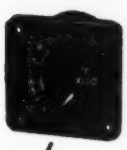
Copyright 1953 by The Instrument Publishing Company, Inc. Office of publication, 1600 North Main Street, Pontiac, Illinois. Executive and Editorial Office, 921 Ridge Avenue, Pittsburgh 12, Pennsylvania.

Entered as second class matter, October 14, 1949, at the post office at Pontiac, Illinois, under the act of March 3, 1879.

LEWIS TEMPERATURE INDICATORS FOR AIRCRAFT

TO AIR FORCE SPECIFICATIONS



THERMOCOUPLE TYPE

2" Single shown with removable Bezel. For exhaust temperature, range 0 to 1000°C, Chromel-Alumel.

2¾" Dual shown with removable Bezel. For exhaust temperature range 0 to 1000°C, Chromel-Alumel.

2" Single, for ring clamp mounting. For cylinder temperature, range −50 to +300°C, Iron-Constantan.

RESISTANCE TYPE

12 or 24 volt ratiometers

2" Single, range −70 to +150°C oil temperature indicator, for ring clamp mounting.

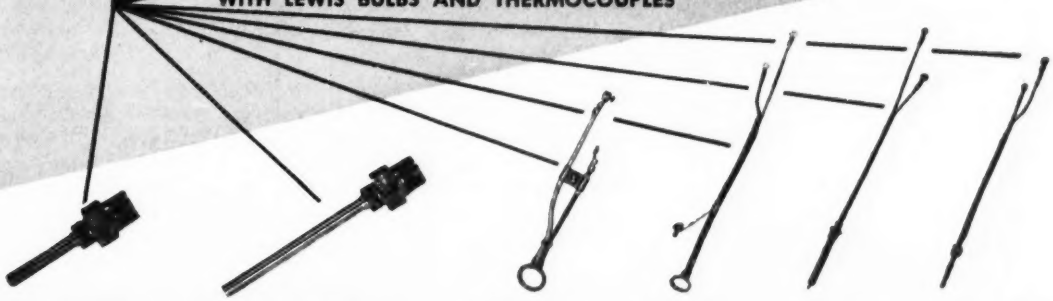
2" Single, range −50 to 50°C for carburetor-air temperature indication, ring-clamp mounted.

2" Single, range 0 to 190°C for oil temperature indication, ring clamp mounted.

Available in all standard ranges for cylinder head, bearing carburetor-air, coolant, oil, free-air and heating-duct temperatures. For best results, use LEWIS resistance bulbs as sensing elements with LEWIS instruments. Any of above instruments may be supplied with type A-1 bezel if specified.

AIRCRAFT RESISTANCE BULBS AND THERMOCOUPLES

FOR BEST RESULTS USE LEWIS INSTRUMENTS WITH LEWIS BULBS AND THERMOCOUPLES



STANDARD AN5525-1 with 1⅞ in. stem

STANDARD AN5525-2 with 4 in. stem

AN5540-1

AN5540-2

AN5545-1

AN5541-1

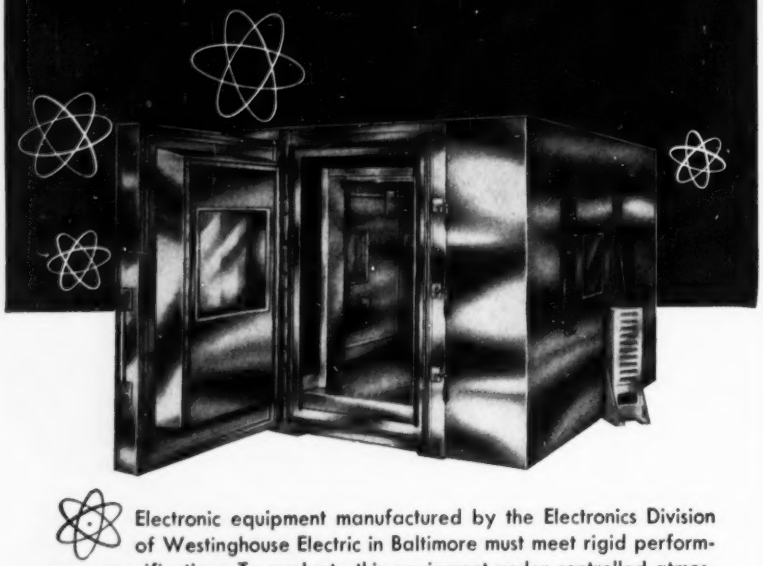
In addition to the standard "AN" Types illustrated, we manufacture thermocouples for test work as well as special types to customer's specifications.

THE LEWIS ENGINEERING CO.

Manufacturers of *Complete* Temperature Measuring Systems for Aircraft

NAUGATUCK, CONNECTICUT

Westinghouse makes SURE.. with BOWSER test equipment



Electronic equipment manufactured by the Electronics Division of Westinghouse Electric in Baltimore must meet rigid performance specifications. To evaluate this equipment under controlled atmospheric conditions, Westinghouse uses a Bowser Walk-In Room which will simulate temperatures from −85° F. to +176° F., and relative humidity from 20% to 95%. In addition, pressures found at altitudes up to 80,000 feet can be created. The entire test facility is operated and controlled from a remote control station.

The complete room was designed, built and installed by Bowser.

This unit is an example of what Bowser can do to help anyone whose products require testing, processing, or stabilized storage. Environmental simulation units, as well as other Bowser equipment, can be engineered to meet individual requirements with unlimited specifications for size, temperature and humidity ranges and peak altitude.

Why not take advantage of Bowser's long continuous experience, the first and best in the field. Our trained engineers are available for consultation at your plant without obligation.

PROGRESS REPORT

To meet the increasing demand for Bowser test equipment, a new building containing 5,000 sq. ft. of floor space has just been added to our facilities . . . and to carry on our policy of independent research, we have doubled our engineering staff.

✔ CHECK AND MAIL TODAY

BOWSER TECHNICAL REFRIGERATION, Terryville, Conn.

Send information on test equipment checked:

- ☐ High Temperature
- ☐ Low Temperature
- ☐ Temperature Shock
- ☐ Humidity
- ☐ Altitude
- ☐ Walk-In Rooms
- ☐ Fungus Resistance
- ☐ Rain and Sunshine
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THE MAGAZINE OF MEASUREMENT INSPECTION · TESTING · CONTROL

Published by
The Instruments Publishing Company
921 Ridge Avenue
Pittsburgh 12, Penna.

Richard Rimbach, *Publisher*
Manoel F. Béhar, *Editor*
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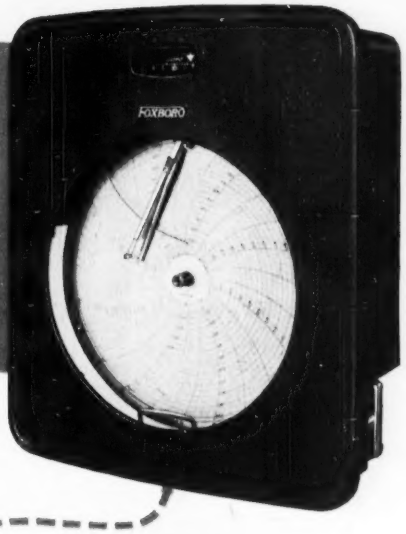
An unbeatable team for temperature measurement

DYNALOG RECORDERS and DYNATHERM BULBS



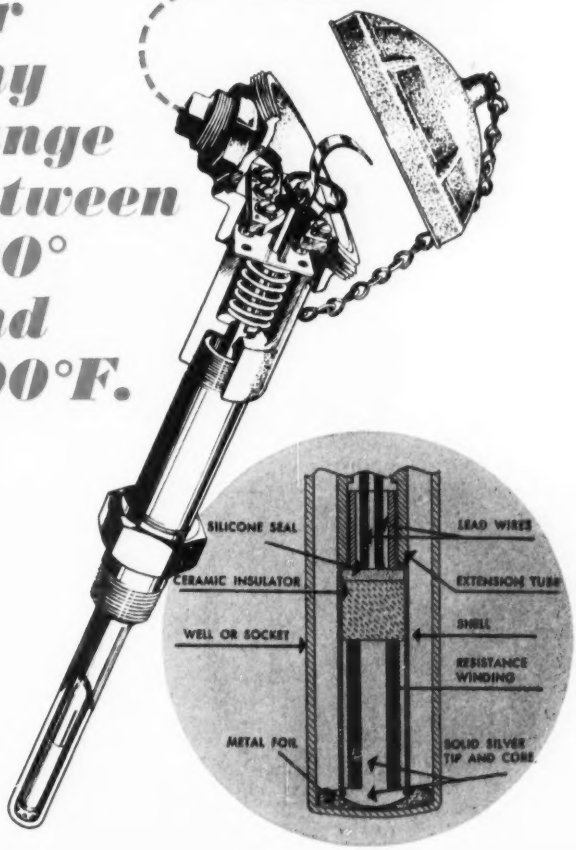
You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between–100° and+600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

The Dynatherm Resistance Bulb has unique features including metal-to-metal end-contact which, when installed in a well or socket, gives a speed of response unsurpassed by any other similarly protected temperature-sensitive element. Exceptionally rugged and permanent in calibration.

These are only a few of the important advantages of this better temperature measuring system . . . available also for control of temperatures, or with Multi-Record Dynalog Recorder for up-to-6 records on one chart. Write for illustrated bulletins, The Foxboro Company, 464 Neponset Ave., Foxboro, Mass., U.S.A.

for any range between -100° and +600°F.



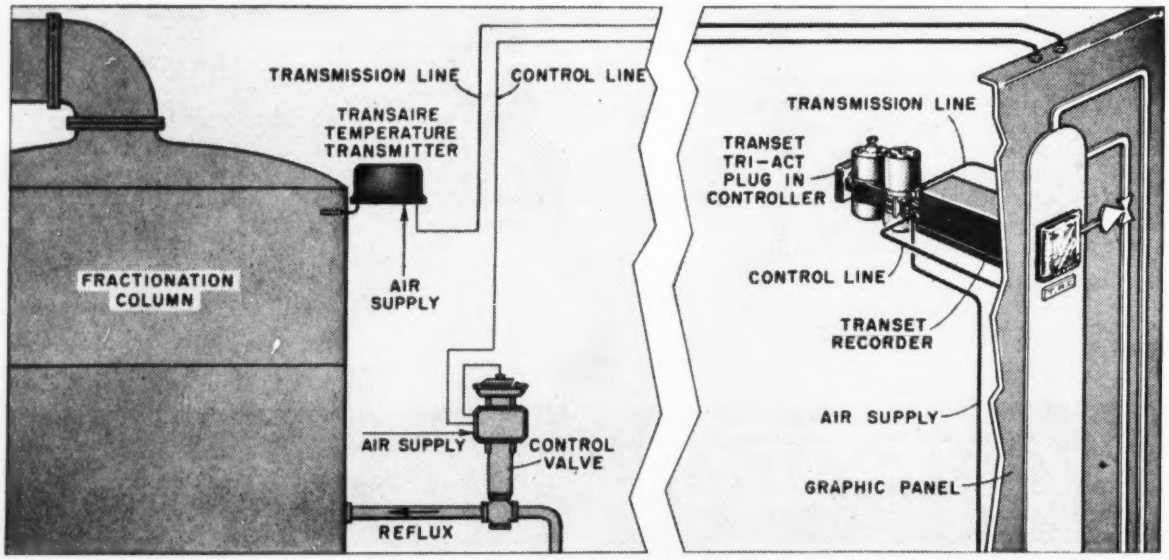
FOXBORO REG U S PAT OFF **INSTRUMENTATION**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

THREE RESPONSE ADJUSTMENTS, calibrated in specific units of measurement, enclosed for protection against tampering and corrosion.

PLUGS IN to universal, self-sealing manifold for either panel or field mounting. Simplifies both piping and maintenance. Manifold accommodates both TRI-ACT and BI-ACT Controllers.

TWIN CYLINDER CONSTRUCTION permits quick, easy access to any one controller element for alignment or maintenance without disturbance to any other element.



Typical application of the 3 part Transet Control System, showing TRI-ACT Controller manifolded to panel-mounted receiver.

Brand New

TRI-ACT®
CONTROLLER

The newest Concept in Process Control gives you:

1. Faster recovery on load changes
2. Start-up with no over-peaking
3. Benefits of automatic reset without its "evils"

THREE YEARS field experience proves new circuit principle not only sound but wanted more than ever. This unique force-balance controller capitalizes on faster speed of response of TRANSAIRE* measuring elements to give better control quality.

Easy Alignment. A fine thread gives a soft, vernier adjustment.

Settings "stay put". Permanent mechanical alignment. No one adjustment affects any other adjustment.

Pneumatically Stable. Practically insensitive to air supply variations. Gives wide range of settings in sensitivity (gain) and Pre-Act time (derivative) without upsetting stability.

Excellent Temperature Compensation — major construction refinements.

Interchangeability of TRI-ACT and BI-ACT* Controllers. Identical plug-in manifolds permit 10-second changeover with negligible process disturbance.

Die-cast Aluminum — light weight and corrosion resistant.

Response Adjustment Dials Totally Enclosed—full protection against tampering and corrosion.

Maintenance Simplified. Any one section of the instrument can be removed for servicing without disturbance to the remaining sections.

Buy one—try one on your toughest problem. There's no better way to prove the unprecedented performance of the TRI-ACT Controller.

Call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

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Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

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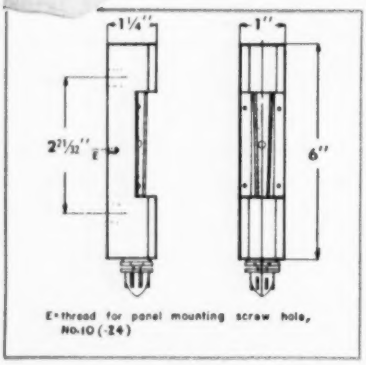
• FLOW INDICATORS • RADIATION TUBES • VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

New, Inexpensive SK Purge Rotameters* Indicate and Permit Manual Control of Fluid Flow in Small Quantities

***featuring a back flow check valve and flow control valve**

$13.00 each, net consumer, F. O. B., Cornwells Heights, Bucks County, Pa. In ordering, always state Fig. No., Meter Size, and Scale Marking.



E-thread for panel mounting screw hole, No.10 (-24)

Here's a really new type Rotameter—the SK Fig. 1846CV Purge Rotameter. It's small (weighs ½ lb.) and inexpensive, yet particularly well designed and sturdily constructed with a one-piece body. It is ideal for use in indicating and manually controlling fluid flow in low flow ranges where good reproducibility but only moderate actual metering accuracy are required.

With this small, variable area type flow meter, the rate of flow of fluid passing through the meter is indicated by the position of a ball float moving in a tapered glass meter tube. The rate of flow is read in reference to the center of the ball float on a scale mounted alongside of the meter tube.

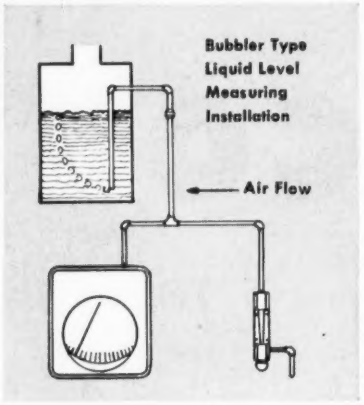
Typical applications include the indication of—

. . . flow of supply air in Bubbler Type Liquid Level Measuring Installations, see drawing.

. . . flow of purge fluid, generally water or air, in the pipelines connecting orifices, venturi tubes, or nozzles to differential head flow meters.

. . . flow of transparent purge fluid to sight glass indicators of Rotameters measuring the flow of opaque fluids.

. . . flow of purge fluid to indicator extensions of indicating Rotameters or to extension wells of Rotameters with electric or pneumatic transmitters where the process fluid carries slurries, tends to settle out crystals, or may form surface coatings.



. . . flow of sample fluid to measuring installations for continuous analysis of fluids.

Special features of the Purge Rotameter include—

. . . a Back Flow Check Valve to positively prevent back flow of process fluid.

. . . a Flow Control Valve for providing sensitive control of fluid flow through the meter over the entire flow range of the meter at differential pressures between 1 to 100 psi across the control valve.

. . . a rigid one-piece meter body which will withstand rough handling in pipe installations and effectively protect the glass tube.

. . . a design particularly suitable for installing directly in pipelines or mounting on instrument panels or in larger instrument cases.

Price, as noted is $13.00 each, net consumer, F.O.B., Cornwells Heights, Bucks County, Pa. Order now.

Meter		Flow Conn.	Rotor Type	Flow Ranges		Pressure Drop	Scale Marking
Type	Size			Water at 70° F	Air at 10 psig & 70° F		
Fig. No.	No.	Inches	No.	gph	cfh	psi	
1846CV	03RZ	⅛ NPT	RB033		.2—2	.8—1	.2—2
	01RZ		RB010	.4—4		1.3—1.5	.4—4
	1RZD		RB10	.1—1* 1—8	.1—2* 2—30	1.5—2	0—10

Note: *Meter and valve bodies are made of anodized aluminum. Control valve shaft is made of stainless steel. Maximum Operating Temperature is 200° F. Maximum Operating Pressure is 200 psig.*

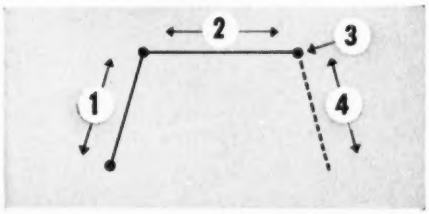
**The low and high flow ranges are obtained in the lower and upper half of the double taper meter tube respectively.*

SCHUTTE and KOERTING Company
Manufacturing Engineers
26 CORNWELLS HEIGHTS
BUCKS COUNTY, PA.
Representatives In Principal Cities

If You're Batch-Cooking You Can Use This Inexpensive Control

Here is a recorder-controller planned especially for economically controlling processes like batch cooking. The Gotham Elapsed Time Recorder-Controller does the essential control jobs easily and accurately. First of all, it brings the batch up to maximum holding temperature fast. It holds the batch at that temperature for a predetermined period. It shuts down the process at the end of the cooking period. Those are its three standard functions. Automatic venting or cooling functions can be added. Also available with a pressure, instead of temperature, system.

Write for full information about the Elapsed Time Recorder-Controller and other Gotham Controllers. They're in Catalog 500.



This Is What the Gotham Elapsed Time Recorder-Controller Does

1. Brings controlled variable (temperature or pressure) up to maximum fast.
2. Holds variable at maximum for predetermined period.
3. Shuts down process.
4. Automatic venting or cooling can be added.

Gotham Elapsed Time Recorder-Controller

SPECIFICATIONS

CHART SIZE: 12"

CASE: Standard - black crinkle; smooth black or white may be obtained.

ACTUATION: Vapor, Gas or Mercury for temperature. Pressure elements available.

CHART DRIVE: Spring wound or synchronous motor.

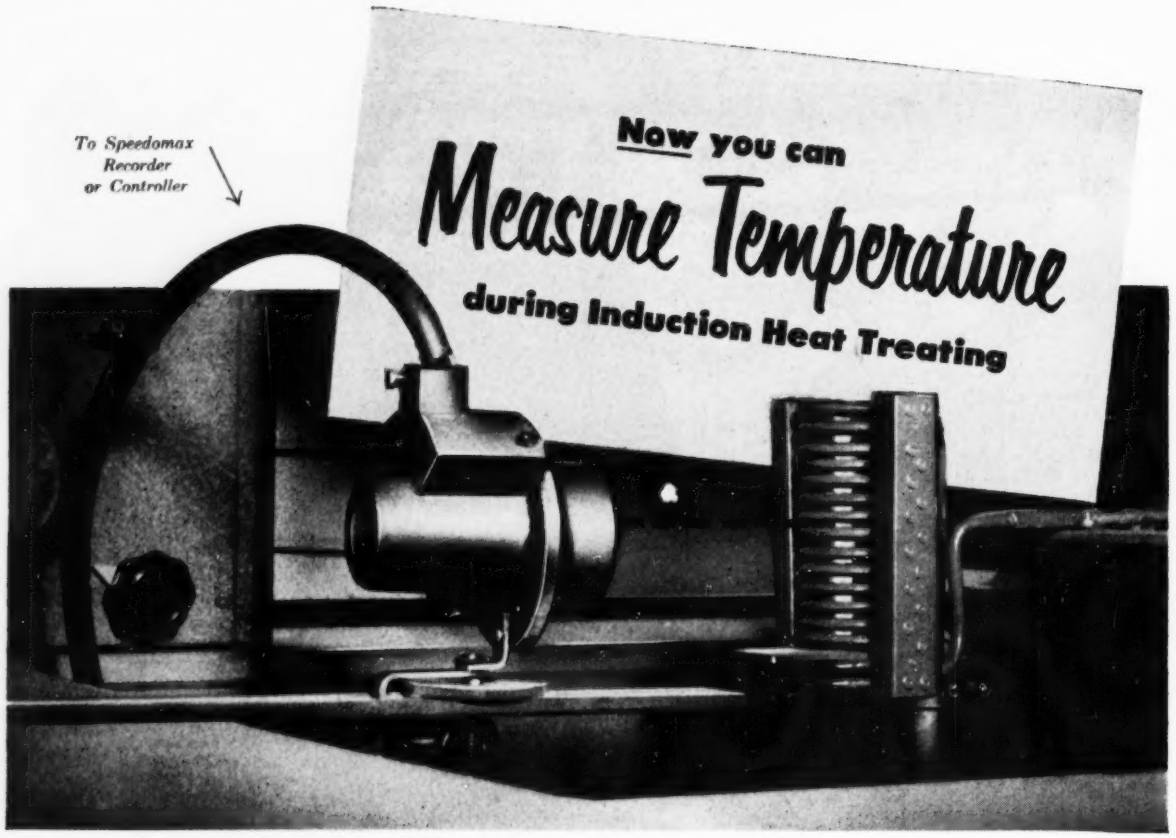
CONTROL SYSTEM: Pilot relay with adjustable sensitivity for 0 to 30% throttling band is standard, two position or 100% throttling band available.

HOLDING PERIOD: Standard 0 to 3 hrs. Other periods available.

Keep Everything Under Control With Gotham

GOTHAM INSTRUMENTS

Division of AMERICAN MACHINE AND METALS, INC.
Dept. 2, 233 Broadway, New York 12, New York



In this simplified set-up the Rayotube detector is sighting on steel bar stock between coils of the heating unit. A Speedomax controller connected to the Rayotube automatically regulates and records temperature.

This installation is at Lehigh University where the Dept. of Metallurgy uses a Lepel High Frequency Induction Furnace to investigate the influence of induction heating on the properties of various steels.

With this new Rayotube detector, it is possible for the first time to measure and control temperature of metal parts being heat treated by high frequency induction during their entire cycle.

Mounted only four inches from the induction heating coil, this newest member of the Rayotube family can focus on an opening as small as 0.1 inch between turns of the coil, and through this opening sight on the hot surface of the work. The Rayotube is so fast it reaches 99% of true temperature in 0.6 second . . . is always within 0.15 second of changes in work temperature.

Teamed with a Speedomax instrument it enables you to automatically measure, record and—if desired—control the entire heating cycle directly from the temperature of the work.

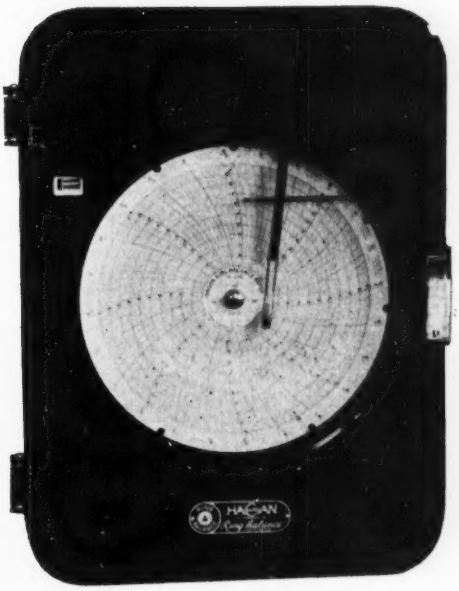
If you'd like more details about using Rayotube detectors on high frequency induction heating or similar applications, just write us at 4955 Stenton Avenue, Philadelphia 44, Pa.

SPECIFICATIONS FOR THE SMALL TARGET RAYOTUBE DETECTOR

Catalog Number	8891-C
Response Time	0.15 second to 63% of temperature change; 0.6 second to 99% of temperature change.
Minimum Target Size	0.1 inch at 4 inch focus
Range	1100 F up
Housing Temperature	Can safely withstand 350 F maximum ambient temperature
Optical System	Narrow-angle, double mirror type with visual viewer
Case	Metal, hermetically sealed, including covered leadwire terminal block

LEEDS NORTHRUP
instruments automatic controls • furnaces

When you install



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METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND AERONAUTICAL TESTING LABORATORIES

Hagan Ring Balance Flow Meters give dependable readings over the chart range, and give good response at low flow rates.

The calibration may be checked under full static pressure conditions by a simple check-weight method. One man can check calibration in a few minutes.

The simplicity of design, coupled with sturdy construction, assure long meter life and low maintenance costs.

The Hagan Ring Balance Meter is the most versatile meter made. Whatever your metering problems, our engineers will be glad to show you how Hagan Meters can help you solve them.

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Please send me further information on Hagan Ring Balance Meters.

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I-4

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REPORTER AT LARGE . . . that's what you might call this new Veeder-Root Reset Magnetic Counter . . . adaptable to remote counting from machines or processes to central boards or instrument-clusters, wherever you want to put them. NOW . . . what can your imagination do with these few facts? For the *full facts,* write:

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Specified....Accepted

wheelco capacilog

- ☆ indicator
- ☆ controller
- ☆ strip chart recorder

...for process variables

"Production-Wise" Benefits of Wheelco Capacilog:

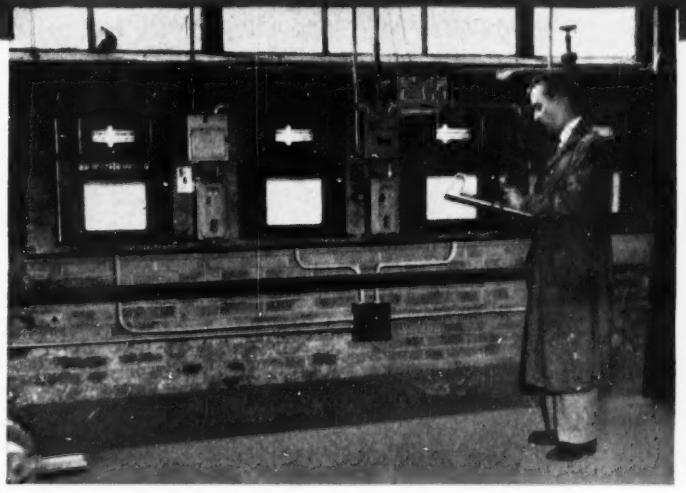
greater uniformity • fuel savings
faster production • reduced spoilage
complete strip chart record

field proven dependability

For years and years Wheelco Capacilogs have been the *specified* instruments for control-recording of process variables in industry.

They are available with high or low temperature measuring systems for pneumatic or electrical control. Ease of chart inspection is provided by automatic chart reroll. Tear-off slot and "Chart-Saver" permit removal of any portion of chart without waste of unused chart paper. Tamper-proof case.

write for bulletin C2-2



Engineers and executives at Alumicast Corporation, Chicago, Illinois, have learned through long experience that they can depend upon Wheelco Capacilogs for accurate, dependable service. Alumicast uses Capacilogs in foundry, die casting, and heat-treating departments.

NATIONWIDE ENGINEERING AND SALES OFFICES

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wheelco instruments division

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Here's How *to Erase* Smoke Troubles

VIOLATION OF SMOKE ORDINANCE

LOSS OF FUEL ECONOMY

BAD COMMUNITY RELATIONS

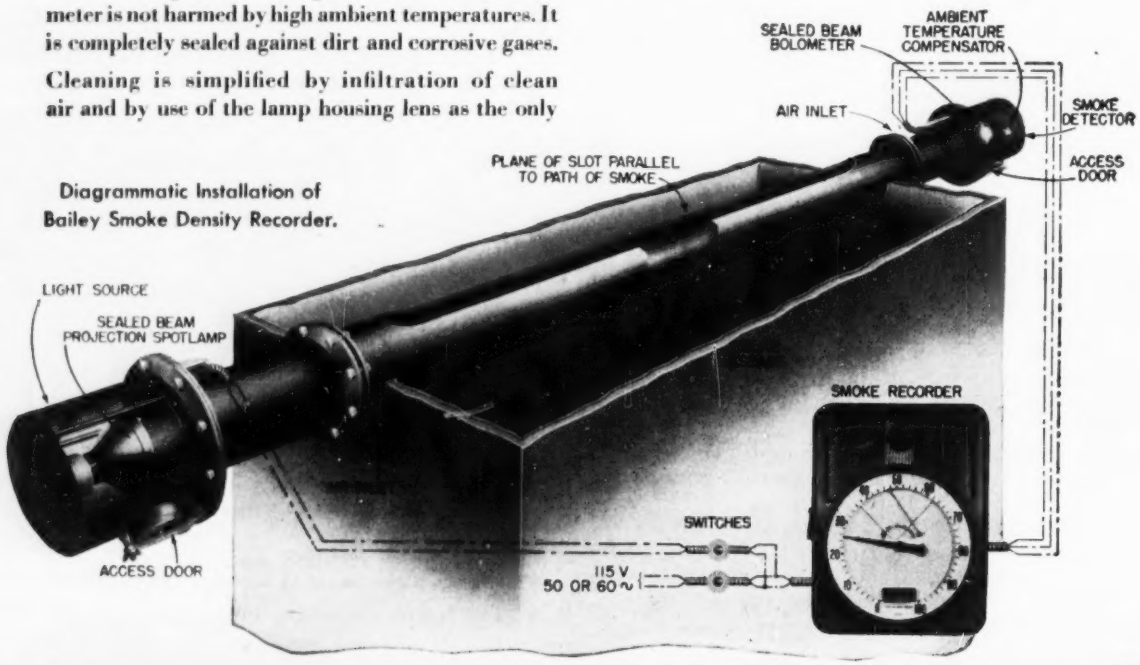
★ One of your first steps in erasing these troubles which result from excessive smoke, should be the installation of a Bailey Smoke Density Recorder. This 24-hour recorder is not an ordinary photo-cell instrument. Instead it detects smoke density by a Bolometer which is simply a sturdy tungsten filament and a parabolic mirror, mounted in a standard sealed beam automobile head lamp housing.

In using this simple, unique smoke detector, you do not have to provide cooling devices since the Bolometer is not harmed by high ambient temperatures. It is completely sealed against dirt and corrosive gases.

Cleaning is simplified by infiltration of clean air and by use of the lamp housing lens as the only window between the Bolometer and the gas passage.

It's easy to secure and maintain alignment of the sealed beam light source with the Bolometer since they are mounted at opposite ends of a slotted pipe which extends across the smoke passage.

For complete information on how you can profitably use this unique instrument to erase your smoke troubles, ask for Bulletin 211, "Bailey Smoke Density Recorder".



Diagrammatic Installation of Bailey Smoke Density Recorder.

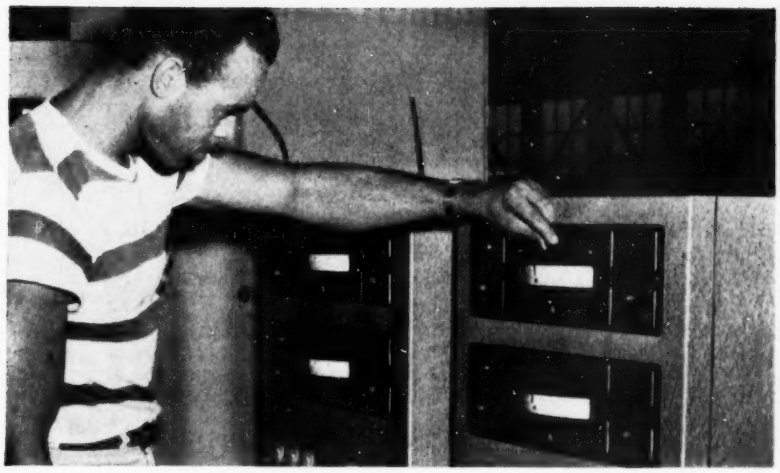
G-29

BAILEY METER COMPANY

1041 IVANHOE ROAD, CLEVELAND 10, OHIO • BRANCH OFFICES IN PRINCIPAL CITIES

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

Let Bailey Smoke Density Recorders Watch Your Stacks



G-E Pyrometers Assure Reliable Control With Easy Maintenance, Sturdy Construction

The General Electric pyrometer is a two-position (on-off) millivoltmeter controller. Besides being one of the most reliable and least expensive types of automatic controllers, the General Electric pyrometer employs an extremely simple and reliable construction, thus assuring dependable operation.

EASY MAINTENANCE

G-E features which make maintenance easy are: a readily accessible plug-in control unit, use of a standard vacuum tube, and three accessible terminals for calibration checking.

STURDY CONSTRUCTION

The instrument mechanism is built around a $3\frac{1}{4}$ lb. Carboloy® alnico permanent magnet. The armature has spring-mounted jewel bearings to provide a high resistance to shock and vibration, thus assuring sturdy construction.

For more information mail coupon below.

G-E Hand Pyrometer Provides Quick, Easy Temperature Checks

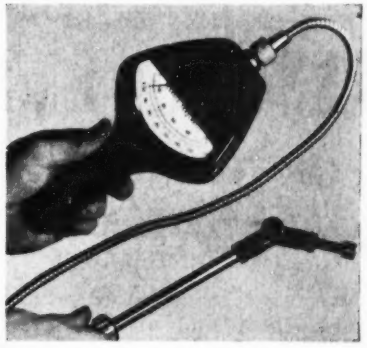
A TWO SCALE RANGE of 0–500F and 0–1500F makes a variety of direct temperature measurements possible with the G-E hand pyrometer. You simply flick a switch to change scales.

THREE INTERCHANGEABLE TIPS

A surface tip, an immersion tip for liquids and molten metals, or a 2-prong contact tip can be supplied with the pyrometer. In addition, a choice of flexible or rigid arms is provided. All tips and extension arms are interchangeable.

The G-E hand pyrometer has a dust-tight, and moisture-resistant case. It is automatically compensated for ambient temperature variations.

Price of equipment shown in photo is $118.17*. For complete information, mail the coupon below.

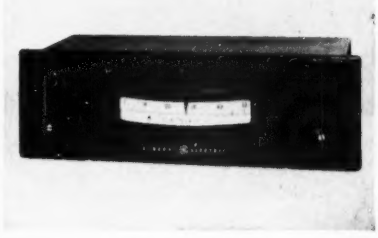


Thermocouple Potentiometer Accurate Within 0.2% Full Scale

This G-E instrument is recommended for temperature measurements in conjunction with thermocouples. Readings can be taken in rapid succession with instrument accuracy held to within .2% of full scale.

Typical applications include refrigerator-development work, oil-burner and air-conditioning tests, steam temperature measurements, and heat-run tests on electrical equipment. Send coupon for Bulletin.

High Accuracy Resistance Thermometers



Temperatures from −100F to +300F can now be accurately indicated and controlled with General Electric's new line of resistance thermometers. They indicate accurately within $\frac{1}{2}$ of 1 per cent full scale. Any change in temperature equivalent to 1/10 of 1 per cent full scale starts immediate control action.

Normal changes in humidity, room temperature, and control voltage do not affect the precision of temperature control; neither does a change in control voltage. Sturdy, simple construction assures reliable operation under severe operating conditions.

Narrow temperature spans, as small as 90°F, are available anywhere in the −100F to +300F range. You can buy four types of resistance thermometers — indicators, protectors, and two- or three-position controllers—for either flush or surface mounting.

Mail coupon below for more information.

*Mfgr's. suggested retail price.

SECTION A602-249 GENERAL ELECTRIC SCHENECTADY 5, N. Y.

Please send me the following bulletins:

- ☐ Pyrometers (GEC-714)
- ☐ Hand Pyrometer (GEC-836)
- ☐ Resistance Thermometers (GEC-835)
- ☐ Thermocouple Potentiometer (GEC-245)

Name .....

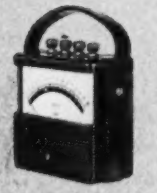
Company .....

Street .....

City ..... **Zone** ..... **State** .....

GENERAL ELECTRIC

Model 622 – Ultra-Sensitive Instruments
Portable d-c and a-c thermo instruments for precision measurement of potentials and minute currents in electronics or laboratory research.



Model 901
Portable Test Instruments
Available in d-c, Model 901 –and a-c, Model 904, single and multiple ranges of wide coverage. Excellent scale readability and shielding. Accuracy within ½ of 1%.

A-C Clamp Volt-Ammeter
(Model 633, Type VA-1) For convenient and rapid measurement of a-c voltage and current without breaking the circuit. Jaws take insulated or non-insulated conductors up to 2" diameter. Safe, rugged, versatile. Also available as a-c clamp ammeter, without voltage ranges.

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For complex, or just routine measurement jobs, these and other specialized WESTON Instruments save time and assure dependable measurements. For information on the complete line, see your local Weston representative, or write . . . WESTON Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

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A line of sensitive relays including the Model 705 which provides positive operation at levels as low as ½ microampere. Non-chattering magnetic contacts handle up to 10 watts at 120 volts.

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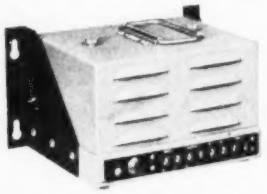
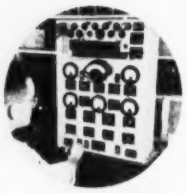
A complete line of instruments in all types, sizes and ranges required for switchboard and panel needs . . . including d-c, a-c power frequencies and radio frequency, rectifier types and D.B. meters.

Model 697 Volt-Ohm-Milliammeter
One of a line of pocket-size meters, Model 697 combines a selection of a-c and d-c current, and resistance ranges. Ideal for maintenance testing and many inspection requirements.



Model 1411 Inductronic D-C Amplifier
Stable amplifier provides high degree of resolution even at fractional loads. Reaches steady full scale deflection in a fraction of a second. Interchangeable plug-in range standards for either microamperes or millivolts.

Industrial Circuit Tester – Model 785
A multi-range, multi-purpose, ultra-sensitive analyzer, for laboratory and industrial checking of electrical and electronic circuits. Has 28 practical scale ranges; measures d-c and a-c voltage, d-c and a-c current, and resistance. Accessories available to extend ranges. Compact and portable; furnished in either oak or steel case.



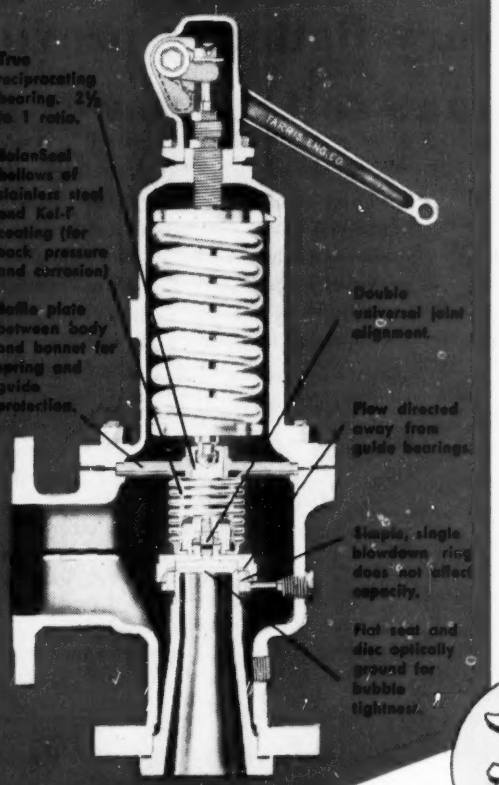
Model 686
Electronic Tube Analyzer
Tests tubes under exact operating potentials. Accurately determines true mutual conductance of all tubes, in accordance with manufacturers' rated operating conditions, or under special operating conditions.

High Frequency Electronic Analyzer
Model 769
A three-in-one instrument providing a self-contained Volt-Ohm-Milliammeter, a high impedance electronic D-C Volt-Ohmmeter, and a probe type Vacuum Tube Voltmeter for use to 300 megacycles. Exceptionally stable and accurate. Has specially designed extremely small RF and D-C probes.

for economical positive* safety...

BalanSeal and FarriSeal Safety-Relief Valves

(Pat'd & Pat. Pending)


True reciprocating bearing. 2½ to 1 ratio.
BalanSeal bellows of stainless steel and Kel-F coating (for back pressure and corrosion)
Baffle plate between body and bonnet for spring and guide protection.
Double universal joint alignment.
Flow directed away from guide bearings.
Simple, single blowdown ring does not affect capacity.
Flat seat and disc optically ground for bubble tightness.

Eliminate all risk of failure—failure that might cost lives or severe damage to equipment. Rely on the only safety-relief valves guaranteed to provide positive protection, 100% of the time, under all operating conditions. Farris safety-relief valves *can't* stick, plug or corrode because the critical working parts are completely isolated from the lading fluid—and they're unaffected by back pressures in the discharge manifold. These unique valves are more economical, too, because they permit higher downstream pressure with smaller discharge piping. In many installations this saving in piping costs amounts to as much as 15 times the cost of the valves. *You* can't go wrong with BalanSeal or FarriSeal Valves because *they* can't go wrong!

Technical manual, 51B, a treatment on Back Pressure Piping and Surge characteristics and 76-page catalog is yours for the asking.

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Mallory Mercury Batteries provide a constant voltage power supply

Mallory Mercury Batteries are especially well suited for transistor power requirements. They deliver constant voltage and constant current . . . an absolute necessity for the best performance of transistor circuits. In addition, they will not deteriorate or lose their energy during long periods of storage . . . even under the most adverse climatic conditions. Their high ratio of energy to size and weight permits miniaturization of electronic equipment.

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If you are designing equipment around transistor circuits, our engineers will be glad to work with you in selecting a power supply to meet your requirements. Multi-cell packs and stacks are available for applications requiring greater capacity or higher voltages than provided by a single cell. Various combinations can be built for virtually any capacity or space requirement. Write us today for more information.

Use Mallory Mercury Batteries for applications where:

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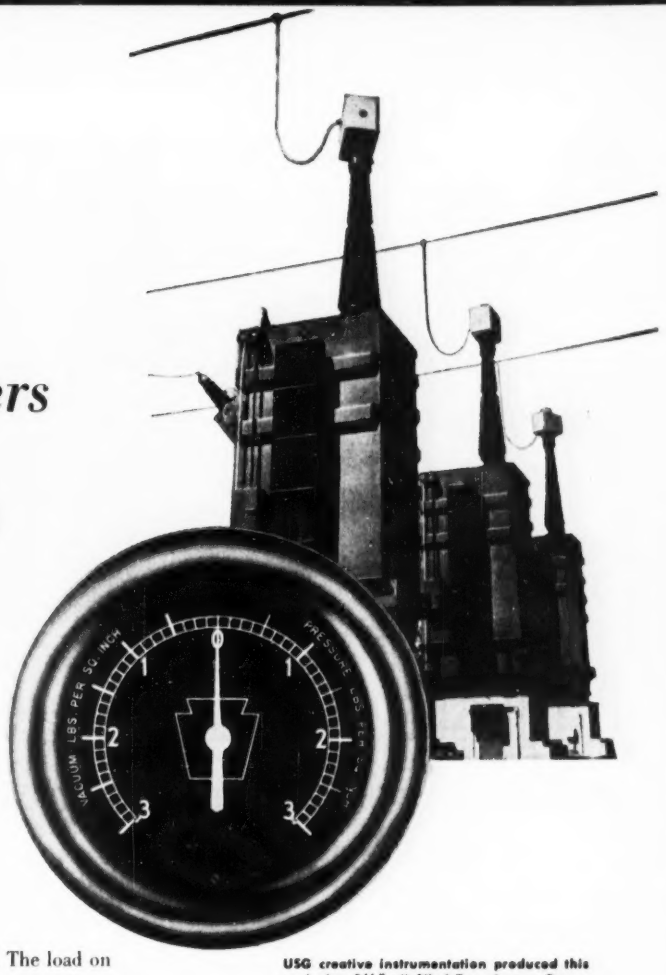
How to tell when transformers suffer from high or low blood pressure



USG creative instrumentation produced this exclusive 3½" oil-filled Transformer Gauge shown above. Oil dampens vibration, permits direct attachment of gauge to transformer. Case actually "breathes", eliminating "barometer effect".

Transformers are sensitive to temperature changes. The load on transformers of the inert-air or gas filled types increases or decreases with the ambient temperature. This could lead to trouble if no visual or aural danger signal were given.

US Gauge studied the need and came up with two solutions—two USG Transformer Gauges. One solution—the USG oil-filled transformer gauge, is so constructed that oil dampens vibration from the transformer making it possible to mount the gauge directly upon the transformer. Vibration which might cause an ordinary compound gauge to fail will not affect this instrument.

The other answer—the USG Transformer Compound Alarm Gauge is capable of being hooked up to any of the warning signals currently available. It provides unusually accurate indication and low switching differentials for a gauge with such low pressure limits.

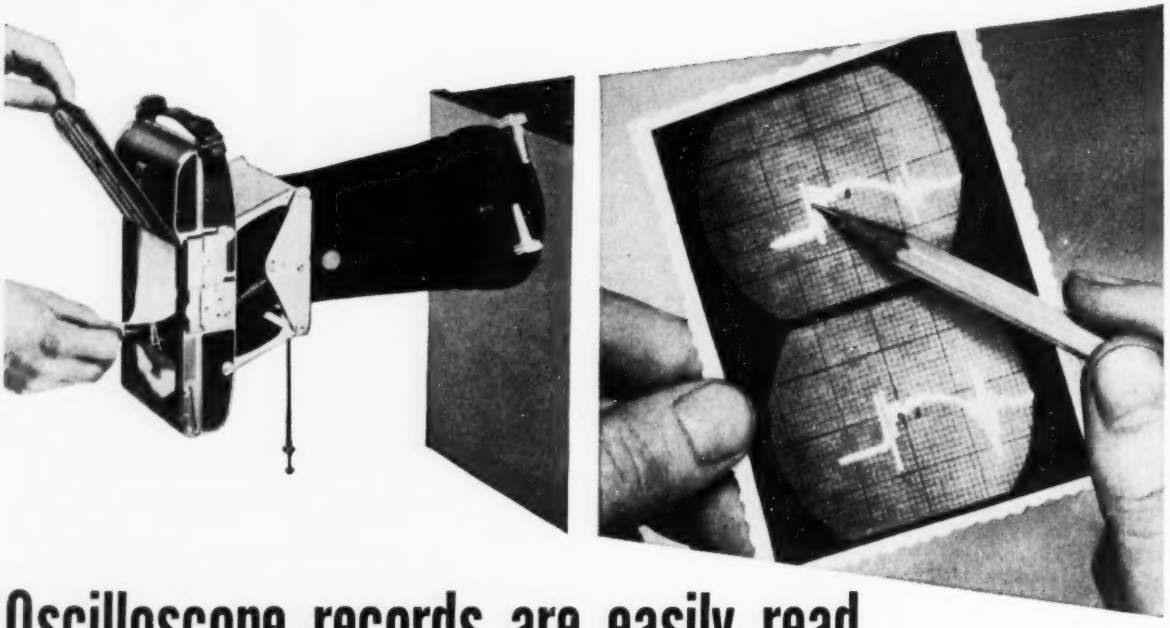
If you are interested in the health of your transformer, you will want us to forward full details on these Transformer Alarm Gauges. If, however, you are more interested in the way USG approaches an instrumentation problem—your problem—get in touch with United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Pennsylvania, and let our Engineering and Production "know how" assist you.

You are looking at the USG 3½" Transformer Alarm Gauge. Note the easily-readable dial and connections for hooking in a signalling system. Separate diaphragms for operating pointer and switches eliminate friction errors.

Quality Gauges Engineered for Enduring Accuracy

UNITED STATES GAUGE

PRODUCTS OF UNITED STATES GAUGE . . . Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • Altitude Gauges • Boiler Gauges Chemical Gauges • Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors' Test Gauges Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges.
OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC. AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS



Oscilloscope records are easily read

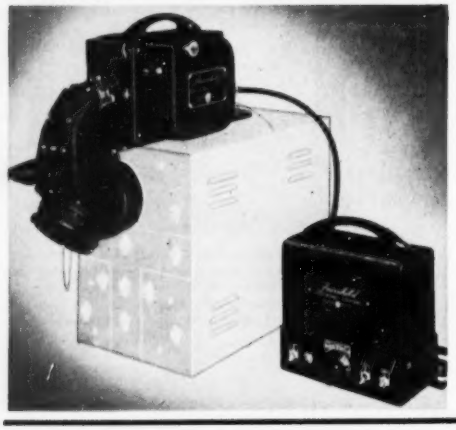
when prints are made with the Fairchild-Polaroid® Oscilloscope Camera

There are three good reasons why oscilloscope traces can be read quickly and easily when they are photographed by Fairchild's adaptation of the Polaroid camera:

1. The trace reads normally—left to right—instead of reverse.
2. Reduction is exactly half life-size for easy measurement of values, especially when a grid is used.
3. Each print records two images, especially handy for before-and-after work.

Operation is as easy as 1-2-3. In two minutes or less you can set up the camera, snap the shutter, and pull the tab. Then you wait one minute more and remove the finished print. No focusing and no special training are required.

Important note—Delivery of Fairchild-Polaroid Oscilloscope Cameras can be had in just a few weeks. Write today for prices and information.



For still or continuous-motion recording on 35-mm film or paper Use the FAIRCHILD OSCILLO-RECORD CAMERA

Speed is continuously variable through an exclusive electronic control. Film is sprocket-driven so there is no slippage. There are no belts or pulleys. Top-of-scope mounting eliminates need for tripod and keeps scope controls easily accessible. Provision for three film lengths—100, 400, or 1,000 feet. Delivery in about four months.

● Full information about the Fairchild-Polaroid and Oscillo-Record Cameras awaits your request. Write today to *Fairchild Camera and Instrument Corporation, Robbins Lane, Syosset, Long Island, New York, Department* 120-19F.

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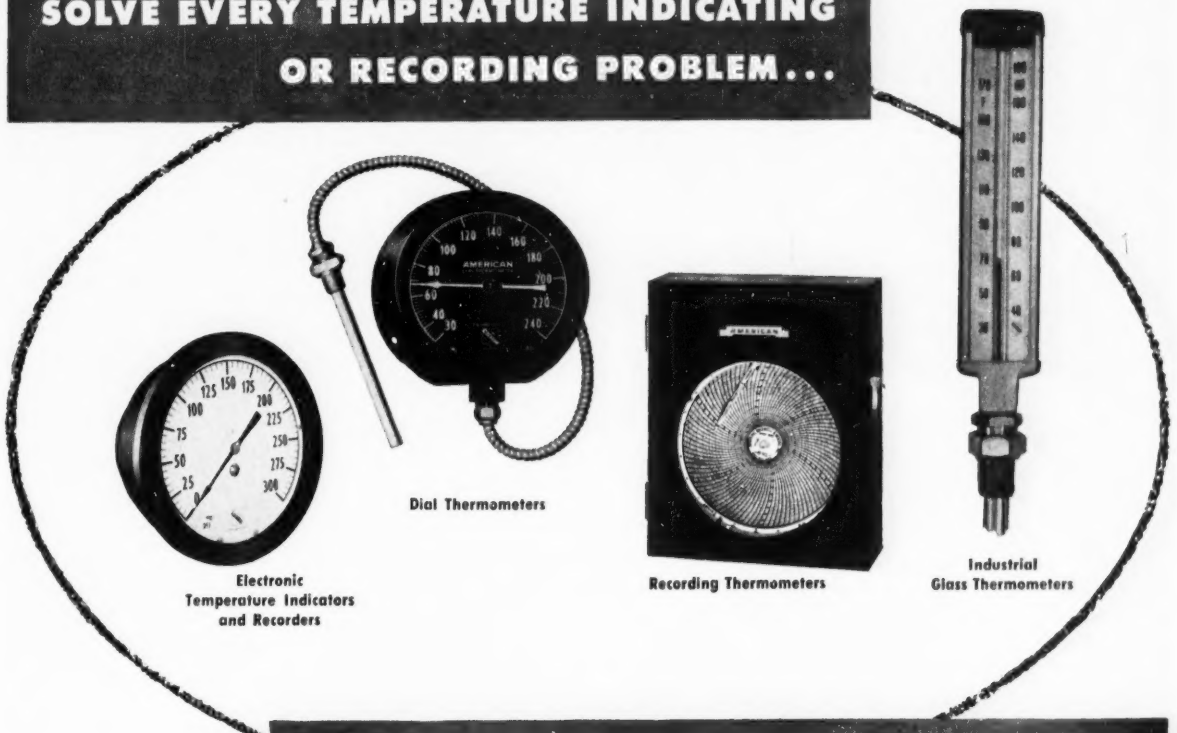
OSCILLOSCOPE RECORDING CAMERAS

SOLVE EVERY TEMPERATURE INDICATING OR RECORDING PROBLEM...



Electronic Temperature Indicators and Recorders

Dial Thermometers

Recording Thermometers

Industrial Glass Thermometers

Specify AMERICAN THERMOMETERS

Maintenance of product quality . . . precise cost control . . . protection of equipment. For whatever reason consistently accurate temperature indication or recording is vital to your operations, choose the best — American Thermometers and Temperature Measuring Instruments.

Unlimited application — determined by the type of instrument and requirements — is evident in the following broad specification information:

TEMPERATURE RANGES: Minus 100°F. to plus 3000°F.

TYPES OF ACTUATION: Mercury, vapor pressure, gas, bi-metal and thermocouple.

REMOTE INDICATION OR RECORDING: For measurements up to 250 feet from the temperature source, accurate mercury-actuated instruments are available with famous "Magic Pulse" self-compensating capillary tubing. To indicate or record process temperatures at one or more points a considerable distance from the temperature source, American Temperature Transmission Systems provide maximum accuracy.

Materials of the highest quality, advanced design, and precision workmanship assure perfect performance in the severest applications. The wide variety of types, temperature ranges, and means of actuation make it easy to select the proper American Thermometers and Temperature Measuring Instruments for your specific needs. Write for catalog.

FOR THE BEST SERVICE, buy through your Industrial Supply Distributor. He has the experienced organization and carries adequate stocks to meet your most exacting requirements and at low cost.

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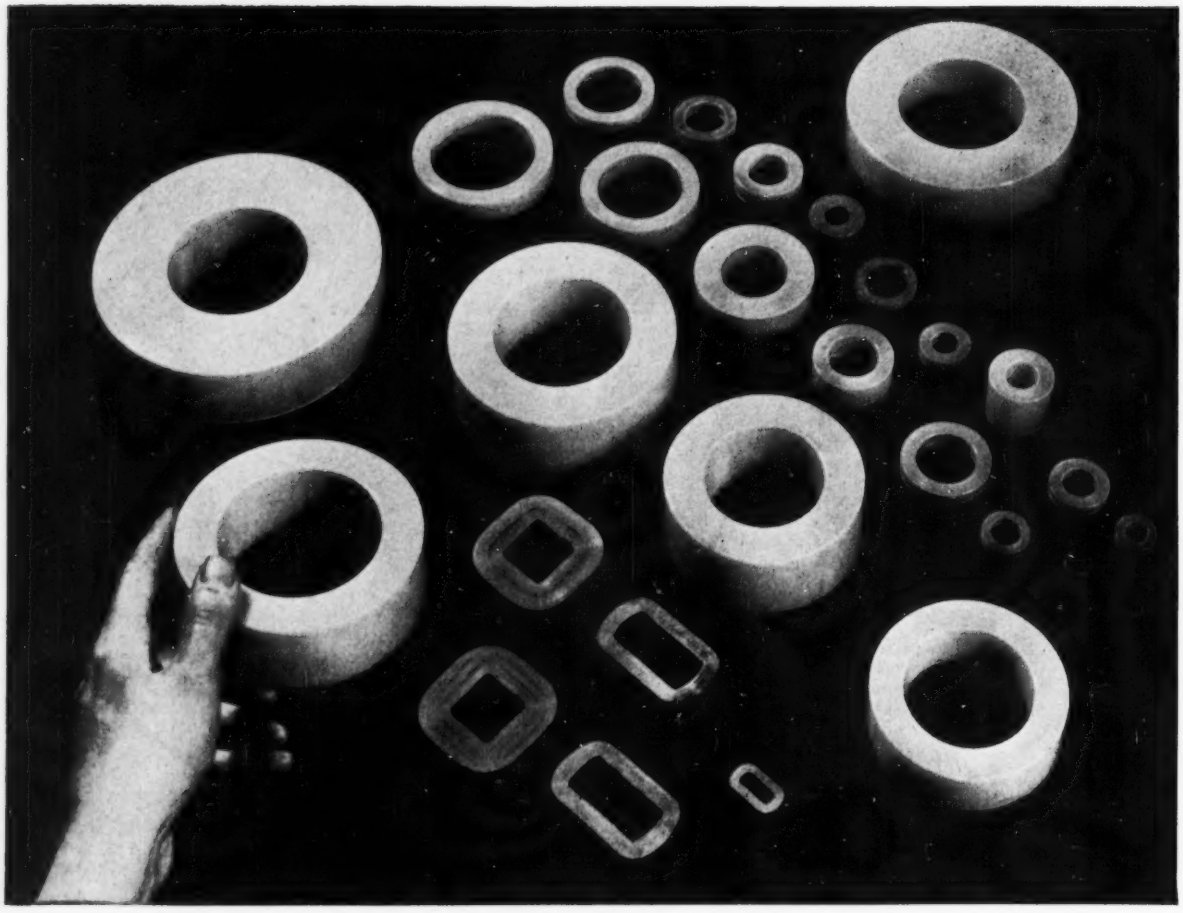
MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES,' CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.



IN *TAPE-WOUND CORES*

JUST NAME YOUR REQUIREMENTS!

RANGE OF MATERIALS

Depending upon the specific properties required by the application, Arnold Tape-Wound Cores are available made of DELTAMAX . . . 4-79 MO-PERMALLOY . . . SUPERMALLOY . . . MUMETAL . . . 4750 ELECTRICAL METAL . . . or SILECTRON (grain-oriented silicon steel).

RANGE OF SIZES

Practically any size Tape-Wound Core can be supplied, from a fraction of a gram to several hundred pounds in weight. Toroidal cores are made in twenty-two standard sizes with protective nylon cases. Special sizes of toroidal cores—and all cut cores, square or rectangular cores—are manufactured to meet your individual requirements.

RANGE OF TYPES

In each of the magnetic materials named, Arnold Tape-Wound Cores are produced in the following standard tape thicknesses: .012", .008", .004", .002", .001", .0005", or .00025", as required.

Applications

Let us help with your problems of cores for Magnetic Amplifiers, Pulse Transformers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Peaking Strips, Reactors, etc.

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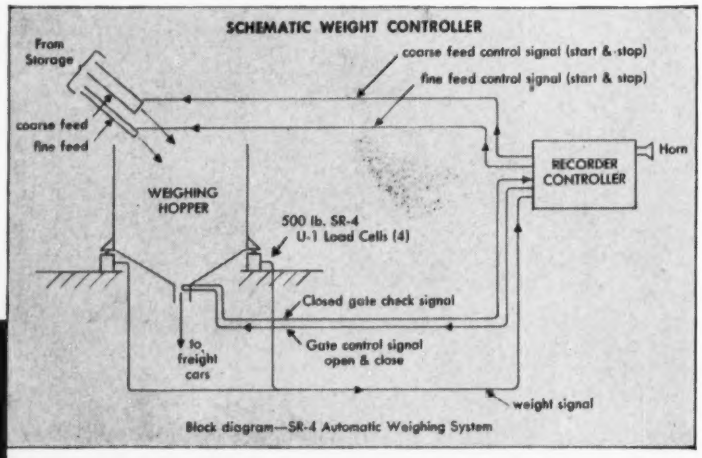
SR-4®—DEVICES IN INDUSTRY . . . *USES UNLIMITED*

Problem: How to weigh automatically an expensive plastic from storage hopper into freight cars.

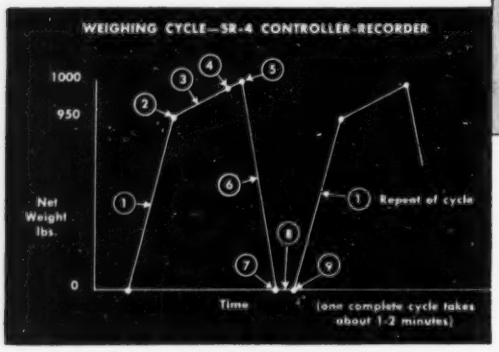
Solution: A large chemical company does it rapidly and accurately with a completely automatic SR-4 Weighing System.

BLOCK DIAGRAM—SR-4 AUTOMATIC WEIGHING SYSTEM. Outputs of four 500 pound U-1 SR-4 Load Cells are totalized into strip chart recorder-controller which furnishes a complete record of each weighing cycle including final and initial weights.

Operator pre-sets the number of cycles. SR-4 controller automatically counts the cycles (1000 lb. each) and stops automatically after the last cycle and notifies operator.



Block diagram—SR-4 Automatic Weighing System



1. Filling weigh hopper with coarse feed (fast).
2. The system shuts off the coarse feed automatically and starts the fine feed (slow). This 950 lb. control point is adjustable (could be at, say, 980 lb.).
3. Filling with fine feed.
4. Fine feed automatically shuts off at 998 lb. (adjustable) . . . to allow for amount of material between feeder and weigh hopper.
5. Check weight 1000 lb. ±1.0 lb. (Adjustable width—±1.0 lb. to ±3.0 lb.) Hopper automatically emptied or alarm if no check.
6. Emptying hopper.
7. Zero check (0.1%, adjustable). Gate closed automatically, or alarm if no check.
8. Time delay relay—automatic.
9. Coarse feed started automatically (after instrument receives signal that hopper gate is closed).
1. Cycle repeats until pre-set number of loads are in car.

This SR-4 System is giving all of these advantages:

- . . . System will pay for itself quickly due to its very high accuracy in weighing large daily shipments of such an expensive material.
- . . . Only one operator needed . . . just part time.
- . . . Speed of operation (less than two minutes per 1000 lb. cycle) cuts costs.
- . . . Automatically furnishes complete record of each weighing for inventory control and billing.
- . . . Rugged construction and absence of moving parts mean that maintenance will be virtually unnecessary except for replacement of vacuum tubes.

Baldwin SR-4 Devices are remarkably versatile and economical for countless industrial applications. You, too, can make substantial savings in your measurement of load, pressure or torque by utilizing SR-4 Devices.

For latest technical information please write for Bulletins 306, 324, 325, 326 and 328, to Baldwin-Lima-Hamilton Corp., Dept. 3015, Philadelphia 42, Penna.

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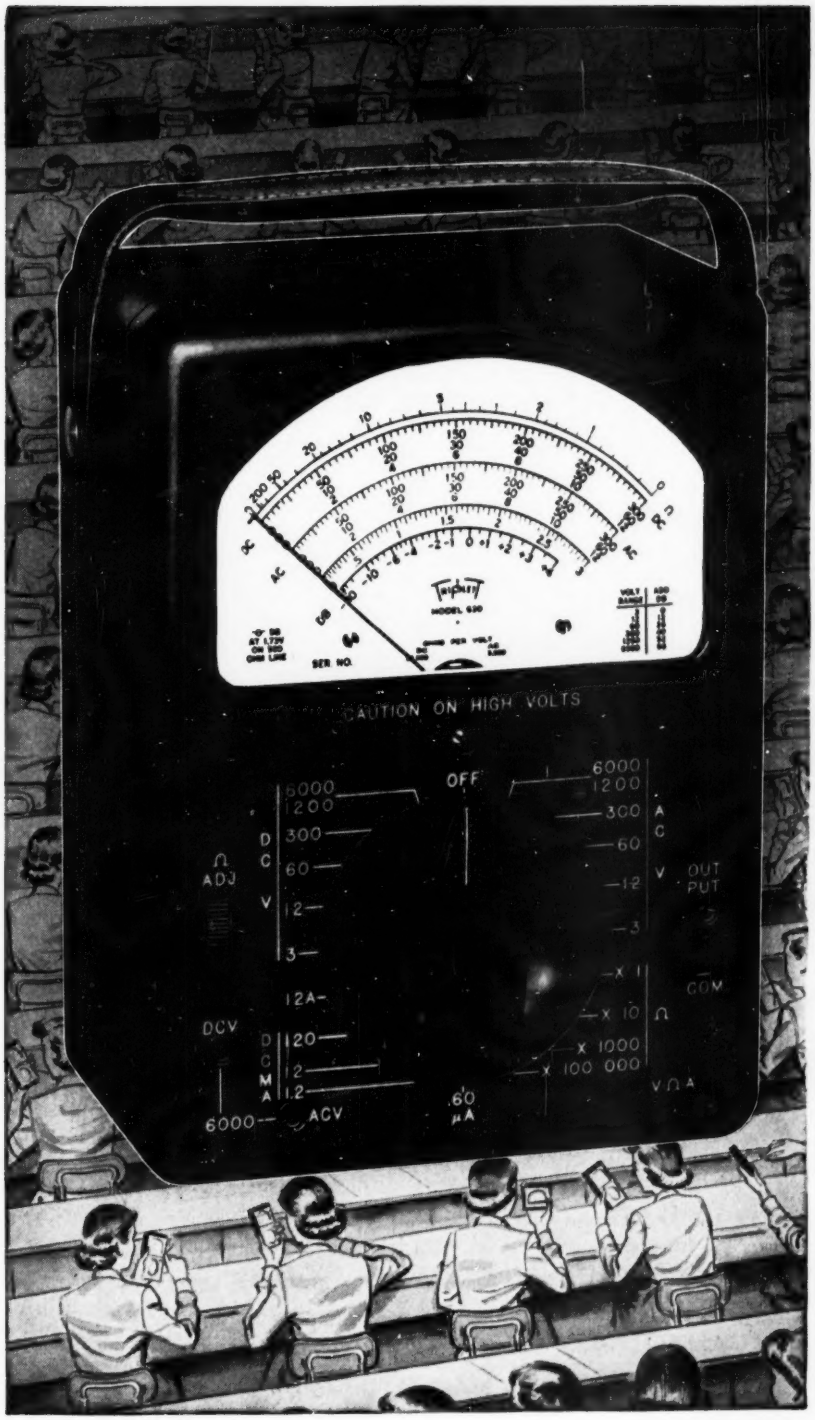

Your dollar buys more "instrument" ...in our Model #630

Volt-Ohm-Mil-Ammeter

by R. L. Triplett
PRESIDENT

Because we build every major part of our instruments the quality is carefully controlled. For example, we know we have more torque driving our pointers because we designed and built the complete instrument. We know we have sustained dependence in the shafts and switch contacts of our test equipment for the same reason. Cycle tests for switches exceed several times the rigid requirements of the armed forces.

There is another important value to you. Because we make our own components we eliminate the profit another manufacturer would make in selling them to us. And this "profit" is passed on to you.

Consider these features of Model 630 V.O.M., for example—

One Hand Operation—One switch with large recessed knob has a single position setting for each reading. Leaves one hand free. Eliminates switching errors, trouble, saves time.

Ranges—AC-DC Volts: 3-12-60-300-1200-6000 (AC, 5000 Ohms/Volt; DC, 20,000 Ohms/Volt). 60 Micro-Amps. 1.2, 12, & 120 Mil Amps. DB scales at 1.73V on 500 Ohm line, 0-66 DB output.

Highest Ohm Reading—To 100 Meg. in steps of 1000-10,000-100,000 Ohms—100 Megohms.

Yes, with us it's a matter of personal pride to make "Triplett" stand for better construction and more service for your test equipment dollar.

R L Triplett
PRESIDENT
TRIPLETT ELECTRICAL INSTRUMENT CO.
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TRIPLETT **630 V.O.M.**
only $39.50

For service, accuracy, highest dependability, buy

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Nash Instrument Air Compressors deliver only clean air, free from oil or dust, and without filters

Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

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No internal lubrication to contaminate air handled.
No internal wearing parts.
No valves, pistons, or vanes.
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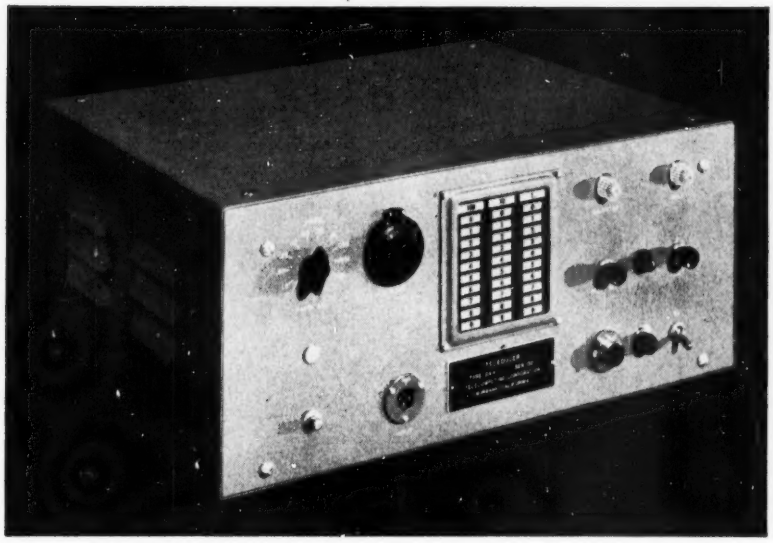

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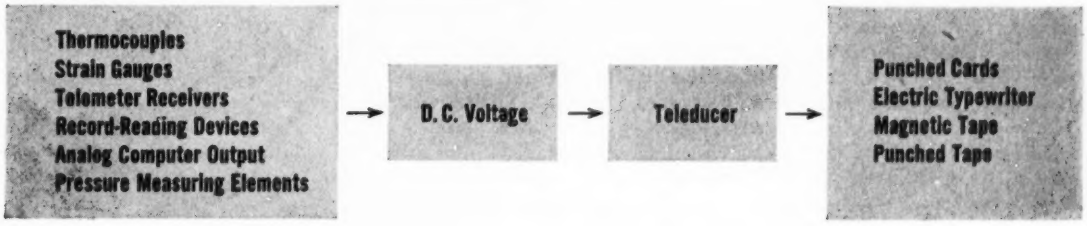

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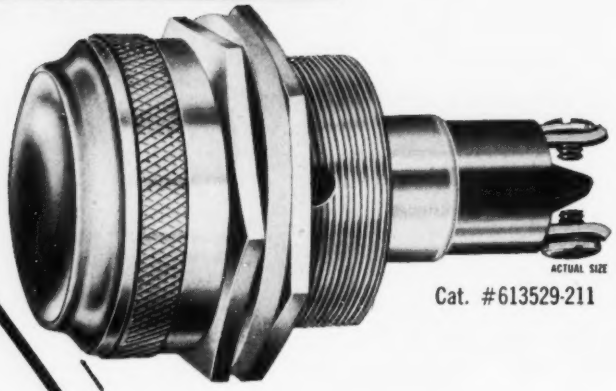
This Pilot Light Assembly was first made to accommodate the *S-11 lamp* and was intended for use in the cabs of great diesel locomotives.



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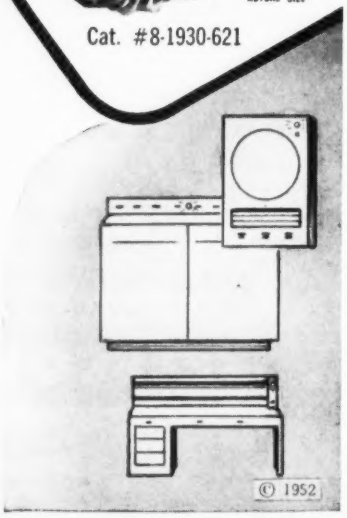

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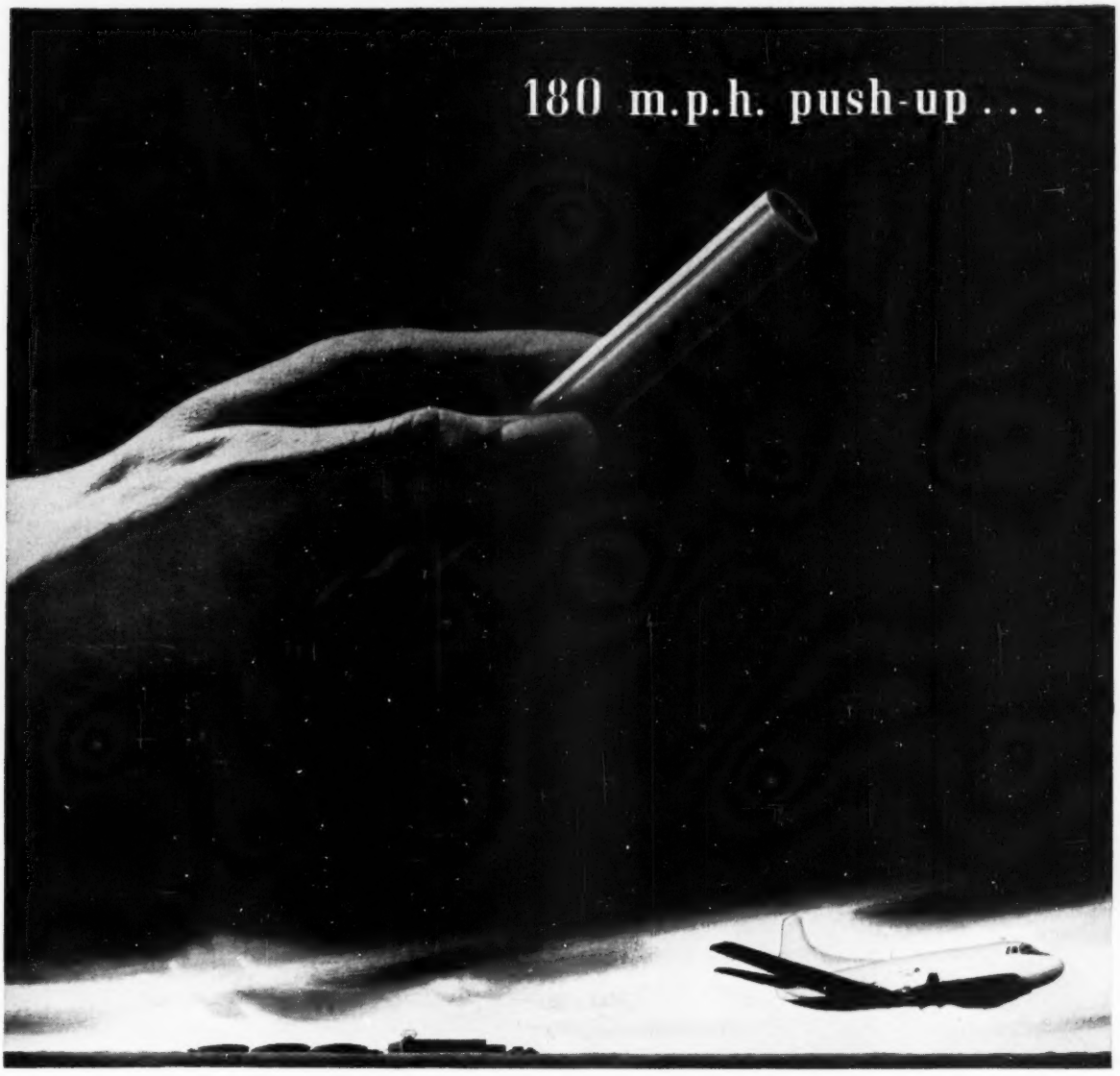

Any time you fly in a Martin 4-0-4, Superior tubing is probably working for your safety.

Once you're airborne, watch the 840-pound main landing gear assemblies flip forward and up with amazing speed, even though they may be working against a 180 m.p.h. drag. Fast landing gear retraction gives you an extra margin of take-off safety because "clean" aircraft have better flight characteristics.

Chances are your Martin 4-0-4 contains many feet of Superior ½" stainless steel tubing. In the hydraulic system, this tubing operates at a pressure of 3000 p.s.i., normally. On Martin's torture racks, it has demonstrated remarkable endurance under violent pressure surges at 1000 cycles *per second*, even around minimum bends.

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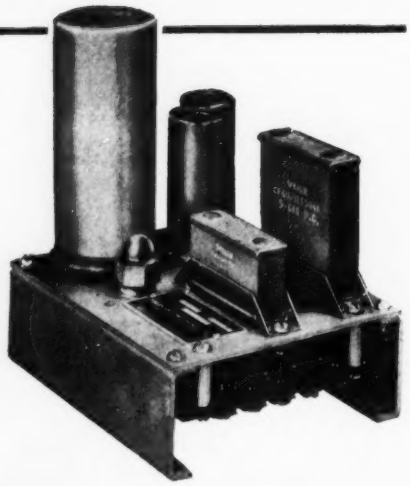

CALIBRATED AGAINST A STANDARD ACCURATE TO 1 PART IN 10-MILLION

The basic unit of this frequency standard is an electronically driven fork,—temperature compensated and hermetically sealed against changes of humidity and barometric pressure. Through its use, any frequency or multi-frequencies between 40 and 20,000, fractional or otherwise, are obtainable.

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Have you a system that requires great accuracy, stability and dependability?

The frequencies shown at the top of the page are but a few among hundreds furnished for precision application in industries, laboratories and Government departments.

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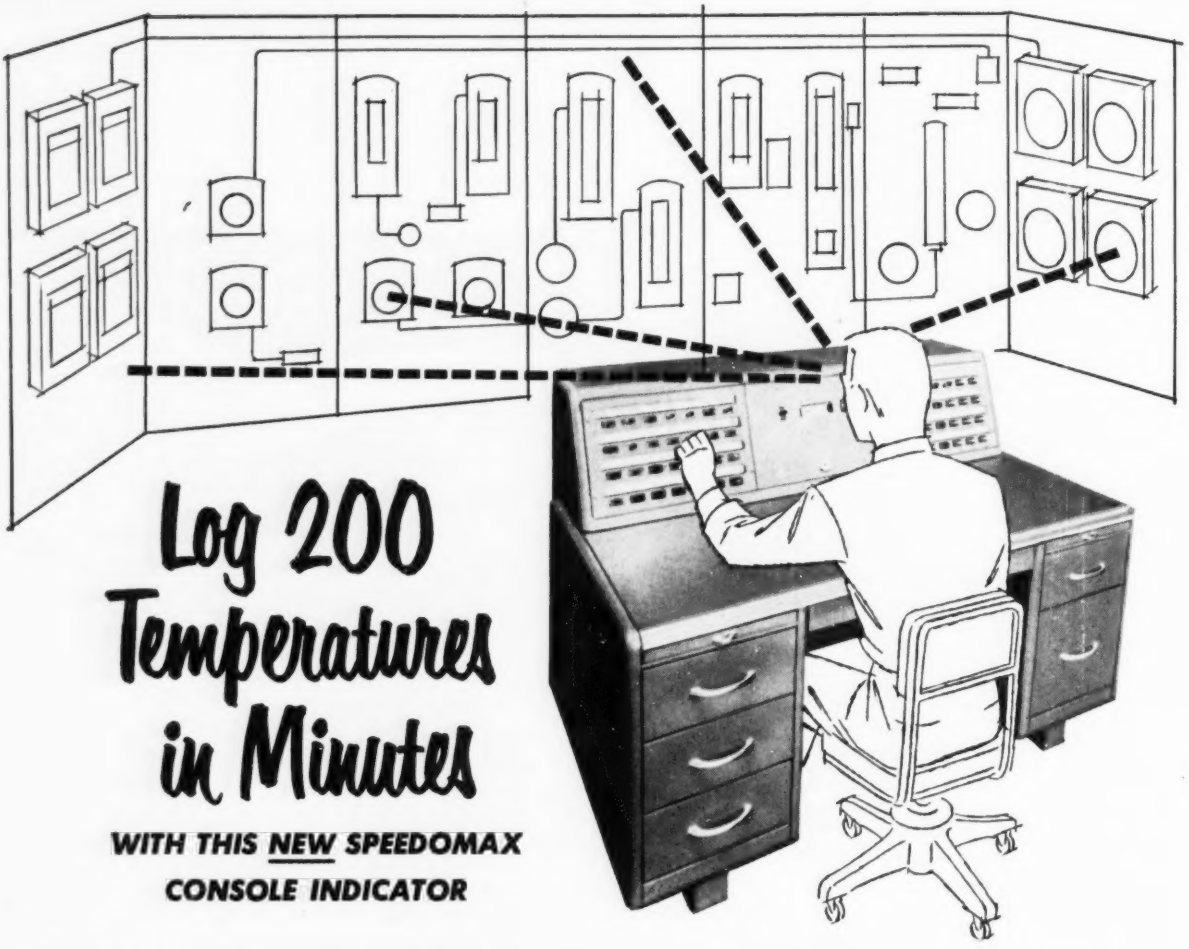

Log 200 Temperatures in Minutes

WITH THIS NEW SPEEDOMAX CONSOLE INDICATOR

Here is a trim equipment that helps even the most modern control room to streamline its appearance and operation. This new Speedomax Console Indicator lets an operator scan up to 200 temperatures as fast as he can log them. What's more, the console extends only 13" above the desk, for an easy, no-stretch view of the main panel. Even when the operator sits as close as 6 or 8 feet from the panel, he has a sweeping view of *all* instruments and flow diagrams. A touch of the switches and he can follow his process during heat balance checks. He can quickly check panel recorders or spot non-recorded temperatures.

Well-Known Electronic Indicator Gives Fast, Easy Readings: The focal point of this new unit is the Model D Speedomax Indicator that is being used in hundreds of plants. In the Console Indicator, the front of its housing slopes at 60° to help an operator read the 25½" drum-type scale with ease. The scale is direct-reading for single or double ranges. It spins rapidly from point to point and stops "dead still." Balancing time is only 4 seconds full-scale, 2.5 seconds half-scale.

Console Design is Functional and Neat: Legend holders and as many as 100 toggle or 96 push-button switches all mount on the sloping panels. Terminal boards are in the roomy back of the console, with big doors for easy access. A large duct conceals all external leadwires. The Speedomax Console Indicator can streamline your control room now. Send the coupon today.

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CHECK THESE FEATURES:

- ✓ Toggle switches permit up to 200 Indicator readings or 100 Indicator and Recorder readings; push-button switches connect as many as 96 Indicator points.
- ✓ Console Indicator saves panel space.
- ✓ Speedomax Indicator slides out of console on tracks; switching panels are removable.
- ✓ For easy identification of points, legend strip holders mount next to switches . . . toggle switch handles can be color-coded.
- ✓ Signal lights, indicating gages, etc., can be mounted on unused switching panel space.
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Editorial Comment

The 1953 IRE Show

THE 1953 IRE National Convention and Radio Engineering Show was held March 23-26 in New York. The vast electronic industry and its many thousands of workers turned out in force to see "A Preview of Progress"—which was the theme of the show.

A more appropriate theme might have been "A Review of Progress." The exhibits were characterized less by disclosures of new products and new techniques than by reviews of products that have been available for some time. The emphasis from last year had shifted from new products and new developments to new designs and new engineering. In line with this trend there was increased interest in components and materials—and decreased activity in new instruments, new techniques, or new products of any type. This was true even with transistors, computers, and radioactivity devices. Although there were several exhibits of transistor supplies (Federated Semi-Conductor, General Electric, RCA, Westinghouse) there was little seen of transistors in operation. A new 2-watt power transistor now available from Federated Semi-Conductor was revealed.

Electrical Indicating Instruments

The new Marion "Multi-Dialer" gives a fresh look to that most basic of test instruments—the multiple-range indicating instrument with permanent-magnet moving-coil movement. In the "Multi-Dialer" the maker has incorporated five ranges; each scale is brought into position by a finger-operated switch that exposes only one scale at a time. As the range circuit and scale are switched automatically and simultaneously, there can be no confusion in reading—and all this is done within the case of a standard panel-mount indicator to which is attached a simple folding bracket that enables the instrument to be carried, hung, placed with the face at any angle for bench work, etc.

There is much interest in vacuum-tube voltmeters with standard-cell accuracy and with high accuracy at all voltage ranges. Thus there was interest shown in the Southwestern Industrial Electronics "Model R" voltmeter with distended-scale feature, and also the Haledy precision null-type VTVM which can be read to 0.1 v./div. to 500 v.

Computing and Data Handling

In the field of computing and data handling, the main emphasis was on recording, although several digital and analog analyzers were on display. The "Elecom" computer of Underwood Corp. attracted considerable interest because it was shown doing weekly payroll functions—salary rates, deductions, totals, etc., at a rate of 35 sec. per employee.

Potter Instrument Co. revealed a new pulse-data handler featuring simplicity and servo-operated reel motors and 5-millisecond start, stop, or reverse time by pulse input.

A new "Complex Plane Analyzer" was exhibited by Technology Instrument Corp. This new instrument multiplies and divides complex vectors and simplifies the work associated with network analysis and control-system design.

There was fairly good representation of counting and timing instruments. Standard Electric Time Co. displayed a new electronic tachometer using glow-transfer tubes. They also displayed an interesting r-f. selective paging system comprising a miniature (pocket-size) 460-Mc. UHF transmitter-receiver with range of 5 miles; up to 1000 channels can be used with 100 crystal-controlled frequencies.

Digital Instrument Co., displayed cycling, preset and gated counters. Atomic Instrument Co. displayed an industrial-type preset counter, also using glow-transfer tube indicators.

R. W. Cramer displayed the new time totalizer, along with their line of timing motors. A. W. Haydon displayed their large line of timing motors and devices.

Oscillograph Recording Equipment

Perhaps the most extensive display of the IRE Show can be said to have been given to oscillograph recording equipment. The beautiful lines of Brush, Century Geophysical, Consolidated Engineering, DuMont, Edin, General Electric, Heiland, Midwestern Geophysical, and Sanborn were on display. Midwestern revealed the new "560" 20-channel oscillograph that can operate under shock of 500 g's. Heiland Research exhibited the new "Model 35-50" miniature portable oscillograph recorder with 12 channels on 35- or 50-mm. film or paper. The Brush 6-channel recorder now is portable and has remote-control features; Brush also revealed new single-channel magnetic recording heads and magnetic-rubber belts for computers. DuMont displayed a large line of camera-recording oscillographs, and a 5-gun 7YP cathode-ray tube. Also of interest in the recording and oscillograph field was the new electrosensitive paper of alfax and the 3XP1 rectangular cathode-ray tube of Waterman.

Several new firms are entering the field of industrial TV. This product is one which is awaiting only effective promotion work; the market is waiting. General Precision and Capehart exhibited new ITV systems.

Research and Industrial Instruments

Instruments of significance to instrument men in industry and laboratories included (1) the pressure pickup and accelerometer of Bendix-Pacific, (2) the sensitive inverter of Boonton Corp., useful to 1 microvolt, (3) the Brush (Bruel & Kjoer) automatic-recording audio-spectrum analyzer, (4) improved General Radio "Variacs," (5) photoelectric instruments and contact-type level detectors of Haledy, (6) the new economical square-wave generator (0.5 cps. to 500 kc.) of SKL, (7) the new automatic circuit scanner and checker and the new transistor-magamp temperature controller of Federal Telephone & Radio, (8) the Victory CO_2 analyzer, thermistors, and varistors, (9) the Ulanet miniature thermostats, (10) the Weston new proportional mutual-conductance tube checker, (11) the new Dyna-Labs gaussmeter, and (12) high-vacuum equipment of National Research Corp.

Midwestern Geophysical exhibited the new No. 4 hydraulic-amplifier servovalve. The new 17 D miniature damped control motors of Servomechanisms, Inc., and the new low-frequency preamplifiers of Servo Corp. of America were displayed. Servo Corp. also displayed a line of radio direction finders.

Radioactivity

There was decided decrease in new products exhibited in this field. Nuclear Instrument and Chemical exhibited a new rapid sample changer and a new scaler. Victoreen exhibited a new dosimeter charger, new vibrators and vibrator power supplies, and new lines of cold-cathode voltage-regulator tubes and ballast-type current-regulator tubes. Radioactive Products displayed a new count-rate computer for use with any scaler, and a pulse-integration system.

Components

There is a trend to unitized construction, with components suppliers offering unitized parts. Alden showed a unitized design now being used by many manufacturers, featuring traceable connections. Sigmund Cohn exhibited microdimensional suspension strip. Kalbfell displayed etched-circuit designs. DeJur-Amsco exhibited special connectors for printed circuits. Miniature and microminiature components were exhibited by many component suppliers.

The technical sessions were characterized by many papers on "systems engineering," emphasizing the fact that the state of the electronics field is maturing into a broader art encompassing basic theories that include a system in which the electronic device is but one part. In this respect the field of instrumentation has been aware of "systems engineering" for 30 years.

The great majority of the new instruments and components described in this report have already been described in "The Month's New Instruments" Department of *Instruments* in recent issues—and some in this issue.

The Month's NEW INSTRUMENTS

In this department we report each month new devices for measurement, inspection, testing, computing, metering and automatic control—in the form of concise technical descriptions.

FOR FURTHER INFORMATION USE THE POSTAGE-FREE ORDER CARD ON PAGE 623

Combination Littrow and Echelle Spectrograph

New "Littrow-Echelle" spectrograph utilizes a new type of optical element, called an echelle, which disperses light into a spectrum as does

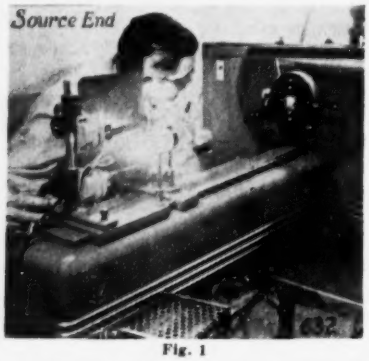


Fig. 1

a prism by refraction or a grating by diffraction, but whose dispersion can be ten times (or more) that of a grating. Thus it would take a con-

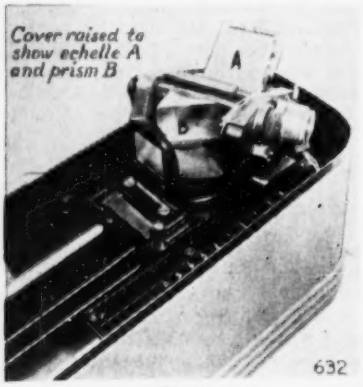


Fig. 2

ventional instrument 72 ft. long to approximate dispersive power of 8-ft.-long new instrument, and larger unit would lack light-gathering power of echelle spectrograph. In this instru-

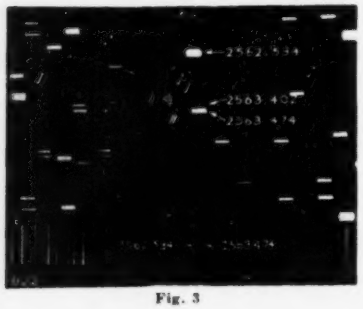


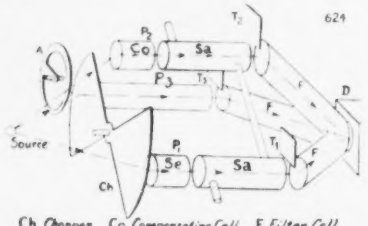
Fig. 3

ment, a prism spreads out spectrum horizontally on spectrographic plate and an echelle spreads it out vertically, producing a new form of spectrogram, called an echellogram, top area of Fig. 3 (where both are iron spectra in 2500-A region). Note resolution of 2563.471 and 2563.402 lines in echellogram which appear as a single line in spectrogram.—*Bausch & Lomb Optical Co., Rochester 1, N. Y.*

Mention No. 501 when filling out card.

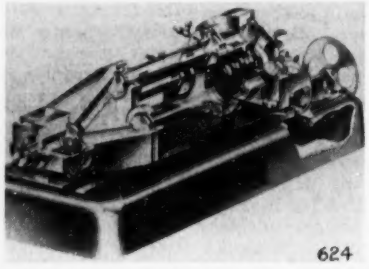
Triple-beam Infrared Plant-stream Analyzer

New "Model 105 Tri-Non Analyzer" is a triple-beam non-dispersion continuous chemical-plant process-stream analyzer, giving a continuous record of



Ch *Chopper* Co *Compensating Cell* F *Filter Cell*
A *Attenuator* Sa *Sample Cell* $T_1T_2T_3$ *Trimmers*
$P_1P_2P_3$ *Paths* Se *Sensitizing Cell* D *Detector*

concentration of one component regardless of number of other components. Principle: if a sample consisting of components I, II, III, IV, etc., is to be analyzed for II, cell Se and detector D are filled with II and T3 is so adjusted that sum of P1 and P3 radiant flux equals P2, whence zero signal at detector. When sample flows,

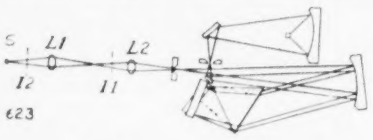


presence of II cuts down P2 radiant flux more than P1. Resultant a-c. signal at detector is used to move attenuator in P3 to restore zero signal. Attenuator position (known function of concentration of II) actuates recorder or automatic controller. If components I, III, IV, etc., have absorption wavelengths in common with II, cells F and Co are filled with partial pressures of interferent components to make instrument effectively sensitive only to variations in II.—*The Perkin-Elmer Corp., Norwalk, Conn.*

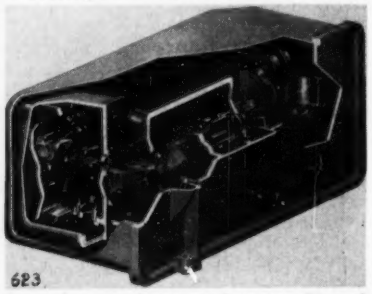
Mention No. 502 when filling out card.

Two-wavelength Infrared Plant-stream Analyzer

New "Model 93 Bichromator Analyzer" is a dispersion-type two-wavelength instrument for continuous infrared analysis, which continuously



records presence of any one desired component in many chemical-plant process streams irrespective of number of other components present. Principle (see Fig. 1): Radiation from source S is focused by lens L1 in sampling area between L1 and L2. Lens L2 focuses radiation on slit where it passes through dispersion system. A split Littrow mirror permits selection of the two analytical wavelengths. These are successively



brought to a focus on detector. I1 and I2 represent the two Littrow mirror images. Instrument (Fig. 2) consists of: (1) source, (2) monochromator and detector, (3) sample cell. First two are separately enclosed and pressurized. Operation of instrument is essentially that of base-line density analysis and is relatively invariant to changes in source temperature or sample cell transmission. Signal appears as a shaft position and may be transmitted to a remote recorder or automatic controller.—*The Perkin-Elmer Corp., Norwalk, Conn.*

Mention No. 503 when filling out card.

Mass Spectrometer for Process Control

New "Model 21-610," industrial-process control addition to maker's line of mass spectrometers, makes high-precision, almost-immediate measurement of any process-gas constituent within mass range 12 to 40. (Where separation between adjacent masses is not important, range is extendable to mass 80.) Other uses include analysis in laboratory, anasthesia control in hospital, etc. Mainte-

nance features insure continuous operation, and automatic protective devices prevent instrument damage. An auxiliary programmer permits periodic scanning of a preselected group of masses, while scanning over instrument's entire range can be readily performed at operator's discretion. Provisions are included for a chart recorder, for command of servomotors, etc.—*Consolidated Engineering Corp., Pasadena 8, Calif.*

Mention No. 504 when filling out card.

Infrared Gas Analyzer for Process Control

New "Model 21 Industrial Gas Analyzer" is a thoroughly industrialized version of "Model 15," for plant-stream analysis. "Pickup Section" (Fig. 1) is housed in a Crouse-Hinds explosion-proof enclosure UL-approved for Class 1 locations, for installation close to sampling point to minimize sampling time. Its periodic

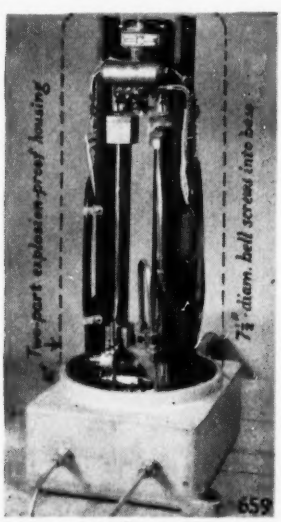
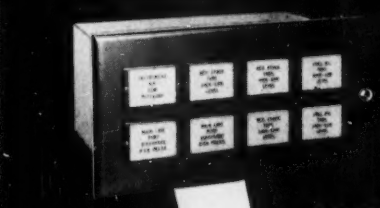


Fig. 1



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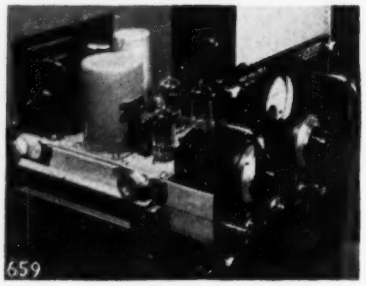


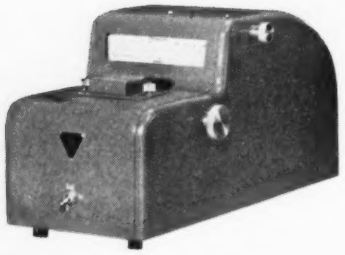
Fig. 2

standardization against standard gases can be made semi-automatic or fully automatic. "Control Section" (Fig. 2) measures 6 x 7 x 13 in., is mounted on slides to make tube replacement easy, can be located up to 400 ft. away from pickup, has all controls, including zero control knob which obviates need of walking to pickup for normal adjustments. Analyzer range can be changed instantly to follow abnormal conditions (plant start-up, etc.) and then reset accurately to normal range. "Control Section" output can be fed directly into any 10-mv. recording-controlling potentiometer.—*Liston-Becker Instrument Co., Inc., 649 Hope St., Stamford, Conn.*

Mention No. 505 when filling out card.

Monochromatic Colorimeter

New "Model 35" monochromatic colorimeter for determining color densities and percentage of light transmission in quantitative analyses is for use in clinical and analytical work, biochemical determinations, food processing and production control, metallurgical analyses, etc. It employs transmission-type interference filters which provide high spectral purity and will not deteriorate with age.



Dual-purpose filter holder accommodates either 2x2-in. or 1x1-in. filters. When holder is withdrawn from light path, light is automatically cut off from photocell to avoid damage. Scale gives direct transmission and density readings by means of a floating spotlight. Precalibrations have been selected to cover commonly-employed clinical procedures.—*Bausch & Lomb Optical Co., 635 St. Paul Street, Rochester, N. Y.*

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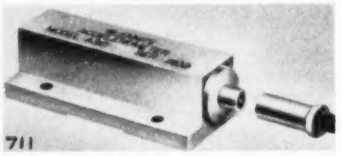
Acceleration Pickups

New "Glennite Series A310, A311, and A312 Accelerometers" are mechanically interchangeable (same mounting holes); usable over wide acceler-

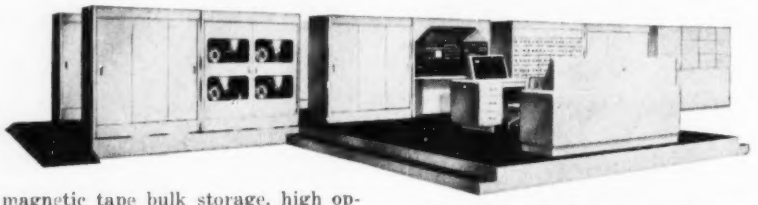


ation range (0.01 to 500*G*) and over wide frequency ranges (to 2500, to 1200 and to 800 cps. respectively). Units are equipped with 4-ft. quick-disconnect interchangeable shielded cables. Prototypes, including cables, have been tested with repetitive shocks of 1000*G*.—*Gulton Mfg. Corp., Metuchen, N. J.*

Mention No. 507 when filling out card.

General-purpose Digital Computing System

New "ERA 1103" ultra-high-speed general-purpose electronic digital computing system provides storage capacity up to 17,408 superspeed registers plus unlimited supplementary magnetic tape bulk storage, high operating speed (60 microseconds per unit of addition) and wide programming versatility. Applications include automatic process control, air traffic control and air defense, aircraft simulation, automatic data reduction, general industrial and economic planning, and scientific-mathematical computation. Operational characteristics, said to make possible electronic computing operations not hitherto possible, include adaptability to most efficient input-output system applicable to problem at hand, such as magnetic tape, teletype communications circuits, card readers, photoelectric tape readers, analog-digital converters, card punches, electric typewriters, high-speed tape punches, process actuating mechanisms, graphic visual displays, or high-speed tabulators. Circuits and controls are designed to facilitate use of preventive diagnostic procedures under synthetically severe conditions so that components of marginal performance are recognized and located before they show up as causes of operational failure. Hence, high degree of immunity to failure during service. Commercial-model delivery in 1954.—*Remington Rand Inc., 315 Fourth Ave., New York 10, N. Y.*



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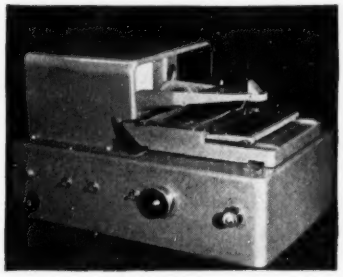
Comparator Densitometer

New Comparator Densitometer for emission spectroscopy is a double-beam null-balance automatic servo-type instrument calibrated to read photo-



graphic densities directly on a linear scale. Line to be measured is located with a comparison spectrum on a scale at 10x magnification. Range is zero to 2.00; zero density point may be arbitrarily adjusted. Smallest scale division is 0.01 density unit; reproducibility and long-time stability are 0.003. Two-speed drive of photographic plate: 0.22 mm. and 1 mm. per minute; also fine manual scan. Optional provision for continuous recording of plate densities with a standard potentiometer recorder. Double-beam null system is unaffected by line voltage fluctuations. There being no galvanometer, instrument is insensitive to vibration and electrical disturbances. Drift problems are virtually eliminated.—*Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.*

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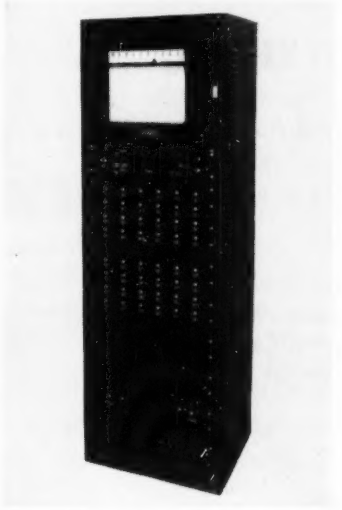
Autographic Plotter for Strain-gage Outputs

New high-speed graphical plotter for strain gages is said to save dollars and manpower through elimination of reading, recording and transposition



errors. Its rapidly-printed data also help prevent failure in expensive test pieces when peak stresses are approached. Dots and numerals are printed on a 12-in. chart at the rate of 48 points per minute. Chart paper

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New Valve Catalog No. 24 brings you up-to-date on the extensive ASCO line of Solenoid Valves (list prices are included). New valves developed and put on the market recently are described in detail *for the first time*. A few of these are:

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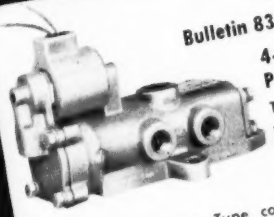

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These two are just examples of new valve data. If you have any need for controlling the flow of liquids or gases in the equipment you are designing or operating, you should find this up-to-date ASCO Valve Catalog useful. Want a copy? Just drop us a note or call up and let us know. We'll be glad to send it to you . . . and extras for your associates if you desire.

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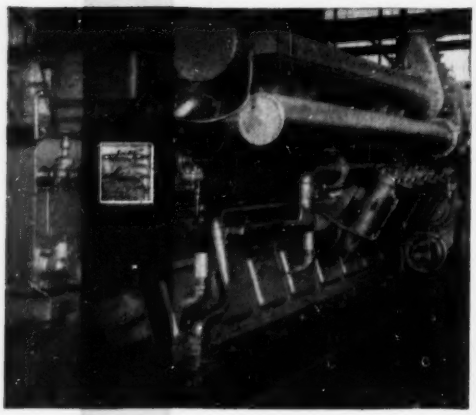
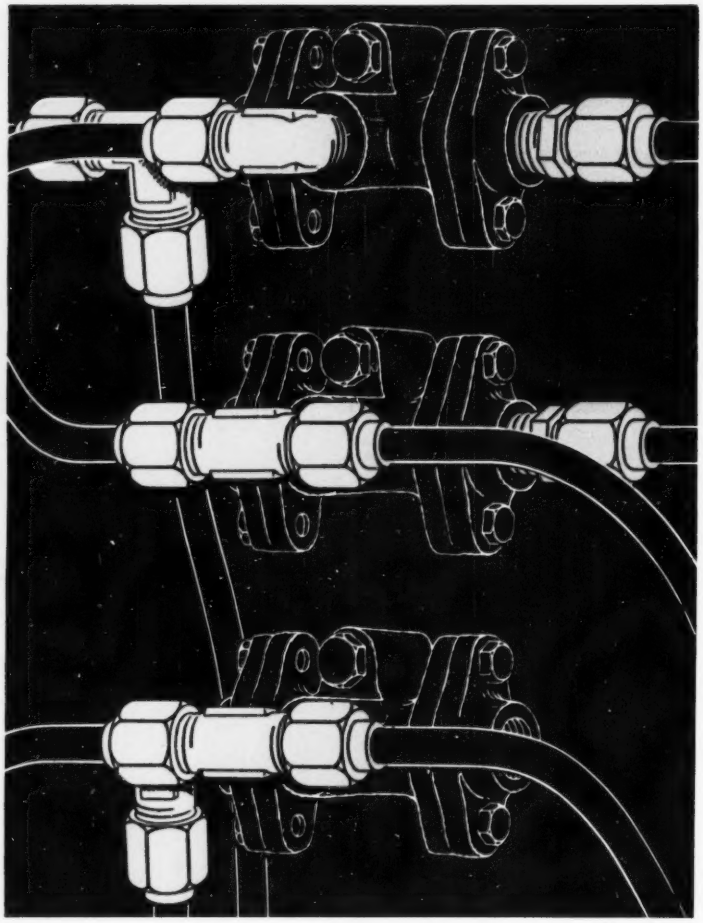


This typical Diesel engine manufactured by The National Supply Company, Engine Division, Springfield, Ohio, is equipped with Parker Triple-lok Fittings.



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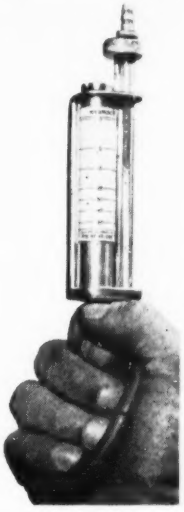
is printed with 5x5-in. graphs, arranged side by side and staggered on 3-in. centers, plotting percent load on vertical axes against strain on horizontal axes. Chart paper may be ejected for immediate inspection and, by running chart through instrument 10 times, a full graphical plot of 48 channels is obtained for on-the-spot checking. Strain scales of 2000, 5000 and 10,000 microinches for a 5-in. graph are available; gage factor adjustment range 1.8 to 2.2.—*Gilmore Industries, Inc., 5511 Euclid Ave., Cleveland 3, Ohio.*

Mention No. 510 when filling out card.

HCN Detector

New "MSA Hydrocyanic Acid Gas Detector" provides a quick reading by squeezing aspirator bulb three times to draw in air sample; any HCN



present turns white reagent granules in detector tube to blue, beginning at end where air sample enters. Length of coloration enables HCN concentrations from 0 to 50 ppm. to be read on graduated scale of tube. Leather kit contains a tube rack, mixing bottle, mandrel, color scale, 12 glass tubes with rubber caps, two vials of granular reagent, and glass-cloth swatches. Sampling hose 10 or 25 or 50 feet long is available, also 3-in. probe for testing mattresses and upholstered furniture.—*Mine Safety Appliances Co., Pittsburgh 8, Pa.*

Mention No. 511 when filling out card.

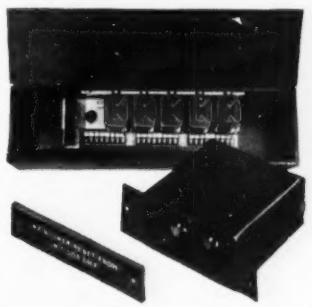
Static Warning System

New "Staticator" system operates when hazardous static develops on machines or when anyone carrying static potential on his person enters protected area. System sounds audible warnings and flashes visual signals in each protected area and on central control panel. Also available is new portable "Staticator" instrument with probe for locating exact spot and indicating whether charge is positive or negative. Instruments are UL approved. for Class 1, Groups C and D. —*The John Hewson Co., 106 Water St., New York 5, N. Y.*

Mention No. 512 when filling out card.

Remote Signal Units

New "Adapter Unit" permits remotely located visual trouble signals to operate as part of a common plant-wide audio-visual annunciator system. For remote visual signals, either individual back-lighted illuminated nameplate units or bullseye lamps are



furnished. Bullseye lamps may also be used with separate ON-OFF lights to form a three-light control station. All signals connect to a common horn or bell which must be acknowledged by operator when an off-normal condition develops. Additional signals may be added to system by inserting plug-in units.—*Panalarm Products, Inc., 6312 N. Broadway, Chicago 40, Ill.*

Mention No. 513 when filling out card.

Cascade Control Unit

New adjustable-ratio relay, for completely automatic control of cascade ratio systems, is a pneumatically-set multiplier which automatically controls output of two ingredients in relation to desired quality of their product. Or it can automatize any cascade system calling for precise regulation of two related variables with respect to a third: combinations of temperature, flow-rate, pressure, level, viscosity, density, pH, etc., where measurements can be translated into pneumatic signals.—*Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia 44, Pa.*

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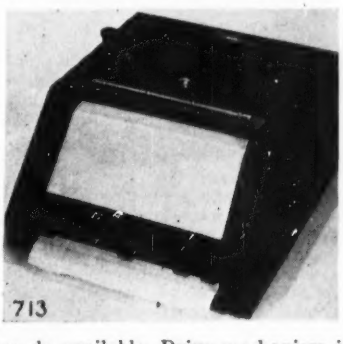
Six-channel Oscillograph

New portable six-channel pen-writing oscillograph has chart drive continuously variable (by knob at top) from zero to 5 in./sec.; higher chart



speeds available. Drive mechanism is so constructed that either six-channel or two-channel chart paper may be used, minimizing chart costs. Chart paper easily replaced without remov-

ing cover. Door at top provides access to inkwells, pens and zero-adjustment levers; plexiglas door provides access to chart paper so notations may be made while instrument is in operation. —*Photron Instrument Co.*, 6516 *Detroit Ave., Cleveland* 2, *Ohio.*

Mention No. 515 when filling out card.

Indicating Viscometer

New 6-in. dial indicator supplements maker's Recording Viscometer; is designed for either panel or wall mounting; can be supplied as an Indicator-Controller for automatic

control. It can be located at a distance from maker's basic measuring elements which measure time required for a piston to fall a given distance through solution being measured.—*Dept. N27, Norcross Corp., Newton* 58, *Mass.*

Mention No. 516 when filling out card.

TEMPERATURE

Furnace-reversal Controller

New "Combined Temperature Recorder and Temperature-Difference Controller" for reversal of regenerative furnaces and glass tanks pro-

vides, for first time in one instrument instead of conventional two, continuous recording of checker temperature, simultaneous measuring of temperature-difference between regenerators, and either automatic furnace reversal or warning for manual reversal when pre-set difference is reached. It draws a two-point continuous line record of temperatures of checkers at opposite ends of furnace: a record of high and low temperatures, with width of recorded band between them showing temperature-difference, easily read at a distance of several feet. New controller is available for use with either thermocouples or "Rayotube" detectors; can be used in maker's complete "packaged" reversal control system, or tied-in with other reversal equipment.—*Leeds & Northrup Co.*, 4955 *Stenton Ave., Philadelphia* 44, *Pa.*

Mention No. 517 when filling out card.

Radiation Pyrometer for Flame-hardening Control

New "Milliscope" autometric pyrometer (made in Germany) was developed to control flame-hardening

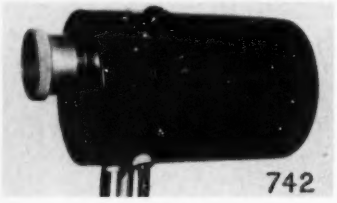
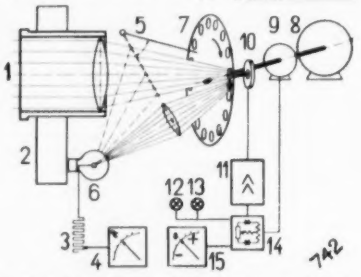


Fig. 1

process where lighting conditions and fatigue cause errors in temperature estimations by skilled operators. Principle (see Fig. 2): Radiant fluxes



1 Radiation from workpiece; 2 water jacket; 3 rheostat; 4 setting dial for filament current; 5 mirror; 6 master filament; 7 chopper; 8 motor; 9 generator; 10 photocell; 11 amplifier; 12 green lamp; 13 red lamp; 14 relay; 15 deviation indicator.

Fig. 2

from workpiece and from reference filament are alternately focused on photocell. If unbalance exists, an alternating emf. is produced, whose phase with reference to 9 indicates direction of unbalance. Filament temperature is preset on left-hand dial so that photocell a-c. output is zero at desired workpiece temperature. Right-hand dial has zero-center scale: pointer at zero indicates that workpiece temperature has reached set-

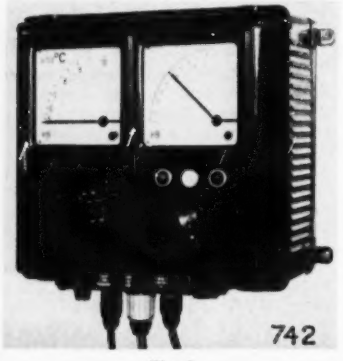


Fig. 3

point. Phase-sensitive rectifier operates relay at set-point, to control burner, to effect quenching, etc.—*Carlingo Commodities Corp.*, 15 *William St., New York* 5, *N. Y.*

Mention No. 518 when filling out card.

Overheat Detector

New "Model 17343-29, Type E-4," aircraft fire-and-overheat detector, capable of prolonged operation at 1000 F., is designed for overheat detection in high ambient temperatures produced by aircraft engines. It can

be adjusted in field to operate at any temperature between 100 and 1000 F.; withstands exposure to minus 100 F., and to high accelerations;' is repeatable after exposure to a 2000 F. flame. Approx. over-all dimensions: 5 in. long, 5/8 in diameter.—*Fenwal Inc., Ashland, Mass.*

Mention No. 519 when filling out card.

Thermistor

New "Type 71A2," added to maker's line of miniature thermistors, consists of a semiconductor head sealed in a glass rod with tinned leads protruding axially. It has a high negative temperature coefficient (about 7 per-

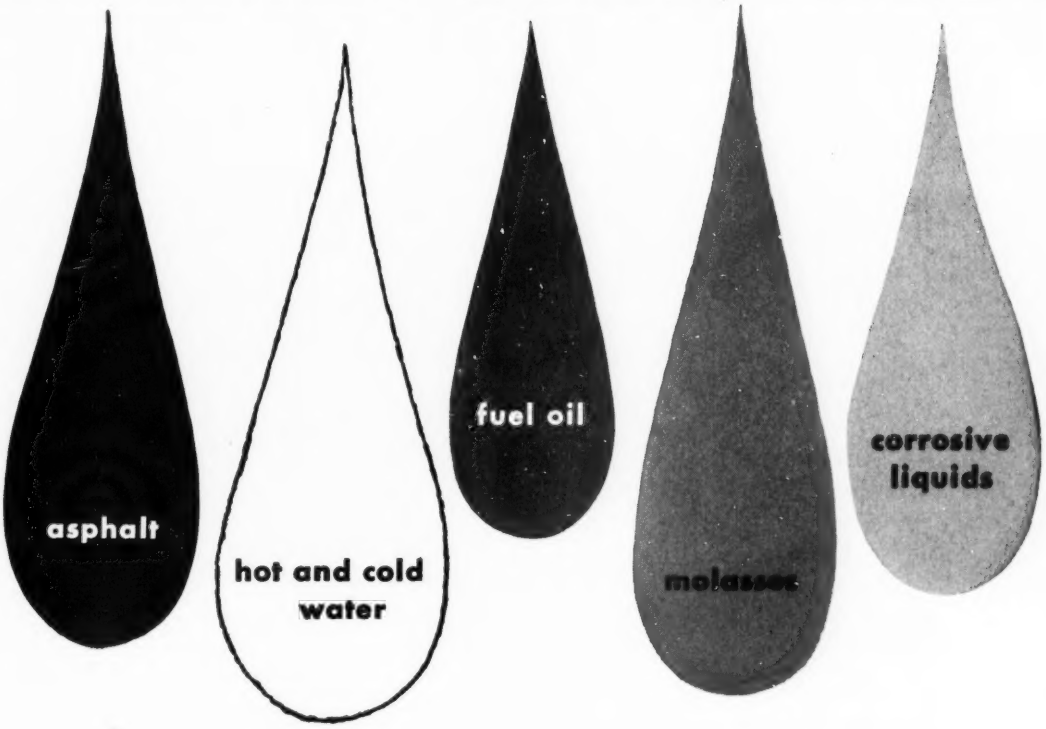
cent at 0 deg. C.). Cold resistance at 0 C. is about 60 megohms and drops to about 3 megohms at 50C. Obvious applications include temperature compensation, particularly making *RC* timing circuits unaffected by ambient-temperature changes.—*Victory Engineering Corp., Springfield Rd., Union, N. J.*

Mention No. 520 when filling out card.

200-TC Console

New console indicator saves panel space, permits an operator to scan up to 200 thermocouple temperatures as fast as he can log them; consists of an executive-type desk with a mounting which houses a 25.5-in. scale "Speedomax" indicator and flanking switch panels. Operator has unob-

viscosities unlimited



HAYS VERIFLOW METER AND HAYS ELECTRONIC VERITROL

indicate and control liquid flow

Now virtually all fluids can be precisely measured and accurately controlled—*from a remote position.*

Hays VERIFLOW meter accurately measures, indicates, and totals the flow of corrosive and hard-to-meter liquids without using weigh tanks, orifice plates, or gage sticks.

With the Hays VERITROL you simply set a knob at the rate of flow desired . . . then, the VERITROL controls the flow of liquid at that set-rate.

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for corrosive liquids

Acetic Acid, Aluminum Potassium Sulphate, Ammonia, Calcium Compounds, Carbolic Acid, Formaldehyde, Fruit and Vegetable Juices, Hydrogen Peroxide, Phosphoric Acid, Potassium Hydroxide, Sodium Compounds, Sulphuric Acid (concentrated), Stearic Acid, and many others.

Automatic Combustion Control
Boiler Panels • Hays Penn Flowmeters
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Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 8, INDIANA

structed view of main control room panel, can easily follow graphic panel diagrams during heat-balance checks, compare values of panel instruments, or spot location of non-recorded temperatures. Indicator balancing time is 2.5 seconds half-scale; scale is calibrated for single or double ranges. —*Leeds & Northrup Co.*, 4934 *Stenton Ave., Philadelphia* 44, *Pa.*

Mention No. 521 when filling out card.

TIMING, ETC.

Time-interval Meter

New "Model 5120 Time Interval Meter" provides a direct reading of elapsed time between any two events, in 1-microsecond increments, to a maximum of 1 second with an accuracy of 1 microsecond plus or minus crystal drift; may be started and stopped by positive or negative pulses by means of polarity-selecting toggle switches. Attenuators permit selection of amplitude of start and stop voltages at optimum level for elimination of interference. Length of time that digital reading is displayed can be controlled manually or automatically (maximum 5 seconds).—*Berkeley Scientific Div., Beckman Instruments, Inc., Richmond, Calif.*

Mention No. 522 when filling out card.

Electronic Counter

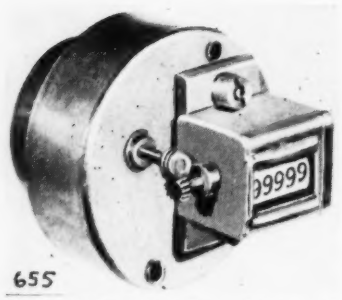
New "Model 522B" precision counter for plant or lab measures rate of occurrences from 0.00001 to 100,000 per second; measures time from 10

microseconds to 27.8 hours; counts occurrences over periods of 0.001, 0.01, 0.1, 1 and 10 seconds or multiples. Time of display can be varied to any duration; counts are automatically reset; action is repetitive; results are shown in cps., kc., seconds or milliseconds, are displayed instantly in direct-reading form, complete to automatic illuminated decimal point. Unskilled personnel can use equipment immediately. Crystal is stable to better than 5 parts per million per week; may be standardized against Station WWV.—*Hewlett-Packard Co.*, 395 *Page Mill Rd, Palo Alto, Calif.*

Mention No. 523 when filling out card.

Elapsed-time Indicators

New "Series ET-1" running time indicators are available in two models: "ET-1A" counts to 99,999 hours by hours, "ET-1B" counts to 9,999.9 by tenths of hours. Size: 2 in. diam. by 2⅛ in. deep. Standard series oper-



ates on 115 volts 60 cycles, can be easily altered for use with other voltages.—*Bristol Motor Div., Vocaline Co. of America, Inc.*, 111 *Coulter St., Old Saybrook, Conn.*

Mention No. 524 when filling out card.

Time Switch

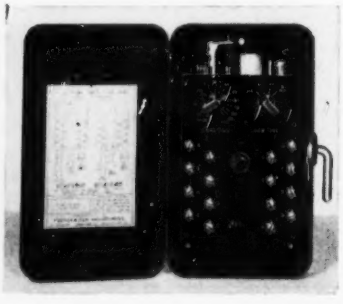
New time switch incorporates completely new and simplified tripping and switching system: a snap ON lever operated by ON trippers on dial and an

OFF lever operated by OFF trippers. 24-hour time dial, moving in standard clockwise motion, carries trippers up against these levers. A ¼-inch motion of lever operates heavy-duty Micro switch controlling load circuit. An interlocking arrangement permits levers to be manually operated without interfering with sequence of automatic operations. Small motion of levers minimizes wear. Steel box 4.25 x 5 x 7 in. with hasp-locked dust-tight cover.—*Lumenite Electronic Co.*, 407 *So. Dearborn St., Chicago, Ill.*

Mention No. 525 when filling out card.

Automatic Timer

New "Type 30HL1" automatic timer, for intervals from 1/20 second to four minutes, provides four basic types of timing: interval, delayed action, automatic repeat, and programming, as well as many variations of these four fundamental types. All combinations may be utilized by changing external connections to terminal board. Basic electronic circuit is self-compensating for changes in line voltage; nor will replacement of electron tube alter the original 2-percent accuracy.—*Photoswitch Inc.*, 77 *Broadway, Cambridge* 42, *Mass.*

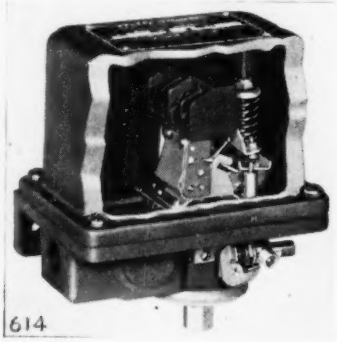


Mention No. 526 when filling out card.

PRESSURE

Pressure Switch

New pressure switch in an explosion-resisting enclosure is available in two distinct types: water pump switch

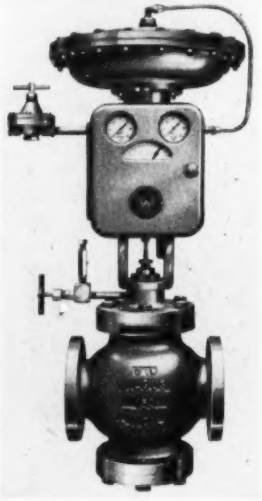


20 to 80 psi. range, and air compressor switch with 40 to 200 psi. range. Units are adjustable over entire pressure range. Enclosure has been designed to meet Class 1, Group D specifications.—*Square D Co.*, 4041 *N. Richards St., Milwaukee* 12, *Wis.*

Mention No. 527 when filling out card.

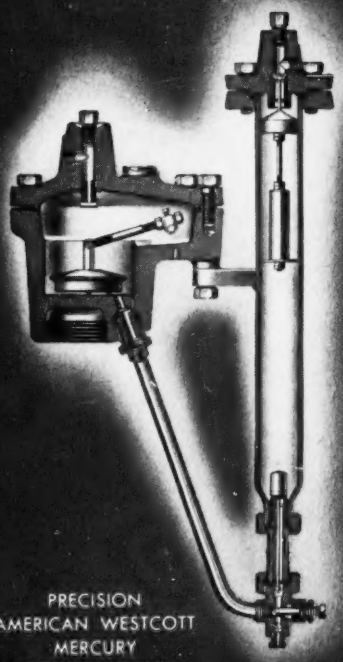
Pressure Regulator

New "Model 50 Twin-nozzle Pilot Regulator" is available in "Type Y Assembly" to clamp around yoke of any "Wilgus N.G.E. Diaphragm Control Regulator" (as illustrated), or in "Type D Assembly" completely piped for attachment to diaphragm top of any regulator now in service. Pilot regulator has Bourdon tube which

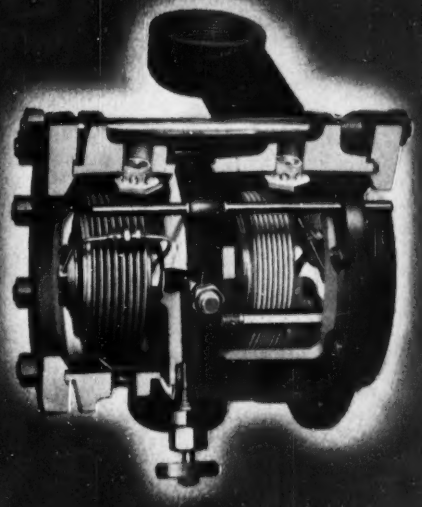


AMERICAN®

offers you TWO BASIC MEASURING INSTRUMENTS



PRECISION
AMERICAN WESTCOTT
MERCURY
ORIFICE METERS



PRECISION
AMERICAN DRI-FLO
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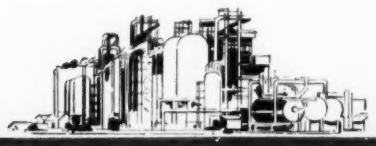
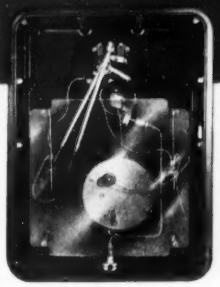
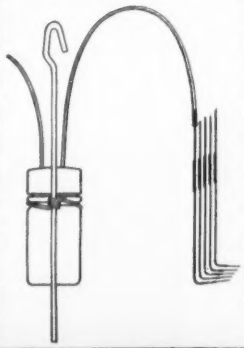
ORIFICE METERS

Your specific requirements for differential pressure measurement will be met with one of these two field proven instruments. Both types are designed to reduce installation and operation problems. Both combine the extreme accuracy, dependability and low maintenance characteristic of all American equipment built under a long-time tradition of "Sustained Accuracy at Lower Cost."

Write for Details







CANNON METER PENS
(Formerly Chartomatic)
FOR ALL TYPES OF RECORDING INSTRUMENTS

Now, American and other types of recording instruments may be equipped with Cannon controlled-flow Meter Pens, if desired. Stainless steel pens are capillary fed by upward flow from a half-ounce reservoir holding and protecting up to a year's supply of ink. These instruments provide maximum legibility and reduce meter inking problems to the bare minimum. They are unaffected by pulsating flows, rapid pen movement, or atmospheric fluctuations and are non-clogging. Available in various styles for all standard recording instruments.

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From Alden's Line of Ready-made Components for Unitized Plug-in Unit Construction:

No more blind connectors

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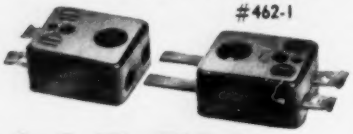
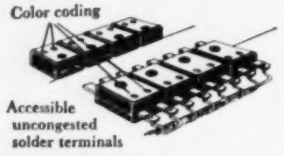


ALDEN PATENTED

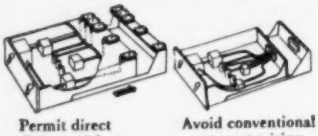
BACK CONNECTORS

Get accessible central check point for all incoming and outgoing leads



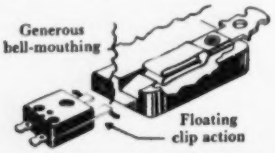
EASY SERVICING, RAPID CIRCUIT CHECKS

Solder terminals easily accessible and uncongested for multiple contact wiring. Color-coding on back connector, corresponding to lead color, identifies each lead for instantaneous check to main circuit or trunk line.



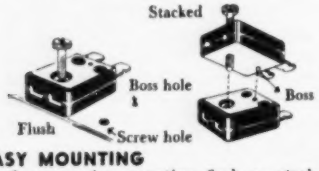
EFFICIENT CIRCUIT WIRING

Connectors can be mounted where desired—to allow for isolation of critical voltages or frequencies—to provide most direct wiring from component to connector—to eliminate rat-nest wiring of conventional methods.



EASY INSERTION AND REMOVAL

Made possible by large bell-mouth entries and ample float of rugged live-action beryllium copper contacts. Wide mating tolerances eliminate critical unit alignment problems.



EASY MOUNTING

Single screw for mounting flush or stacked. Molded locating boss positions and locks connector in place on unit when flush mounted—boss accurately lines up and positions connectors together in stack mounting.

SEND FOR FREE SAMPLES

—also request free "Alden Handbook" 226 pages of techniques and components to help you design your equipment for Unitized Plug-in Unit Construction.

NA-ALO ALDEN PRODUCTS CO.

137 N. Main St., Brockton 64, Mass.

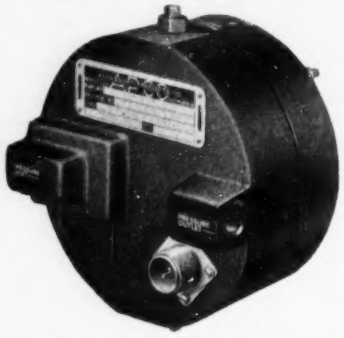
NEW INSTRUMENTS

modulates flow of operating medium through a nozzle mounted in a combination direct- and reverse-acting twin nozzle block integral with setting mechanism. Bourdon tubes in stock for pressures to 1000 psi.; higher pressures special; tube hysteresis is less than 0.1 percent. Worm-and-gear setting device is unaffected by vibration.—*Natural Gas Equipment, Inc., 109 E. Glenarm St., Pasadena, Calif.*

Mention No. 528 when filling out card.

Airplane Radar Pressure Controller

New "Model PR-4" isobaric pressure regulator for airborne pressurized radar systems features a system of valves—one a relief valve—con-



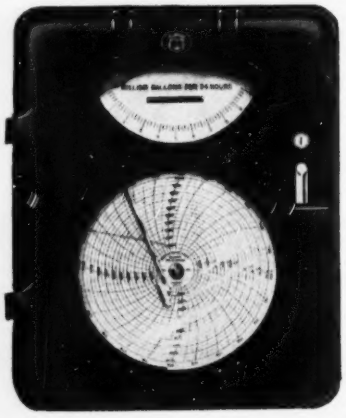
trolled by three aneroid bellows; can compensate for leakage in radar system in excess of 200 cu.in./min. At low temperatures, valves are heated by a thermostatically controlled heating element operating from plane's 28-vdc. system. Unit is also available without heating elements where dry air is used for pressurization.—*Accessory Products Co., 617 Putnam Drive, Whittier, Calif.*

Mention No. 529 when filling out card.

FLOW, ETC.

Indicating, Recording and Totalizing Meter

New "Type H Meter," for measurement of water, gas, air, sewage, sludge, etc., is a mercury-and-shaped-float type indicating, recording and total-

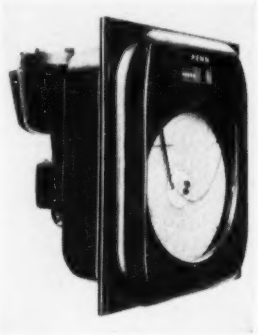


izing instrument, operating in conjunction with Venturi tubes, flow nozzles and orifice plates. It is so calibrated so as to give 2 percent accuracy at any point, over flow ranges as wide as 13 to 1.—*Simplex Valve and Meter Company, 68th and Upland Sts., Philadelphia 42, Pa.*

Mention No. 530 when filling out card.

Flow and Level Recorders, Transmitters and Controllers

New "Magna-Clutch" flow-rate and level instruments feature magnetic coupling between float in mercury manometer and external moving parts,

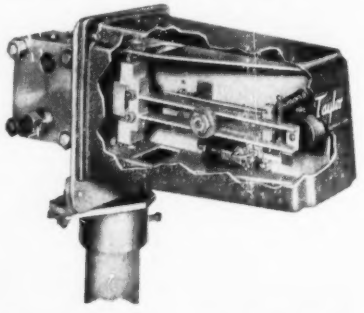


permitting use with corrosive or flammable fluids, minimizing maintenance by elimination of pressure-tight bearing, and preventing impairment of accuracy at high static pressures. Seven interchangeable range tubes (20-in. to 750-in.) and continuous range adjustment down to 50 percent for each range; also bell-type manometers for low (4- to 10-in.) ranges. Instruments are available in recording, integrating, pneumatic transmitting, and controlling types for static pressures to 2500 psi.—*Penn Industrial Instrument Corp., Penn Bldg., Philadelphia 4, Pa.*

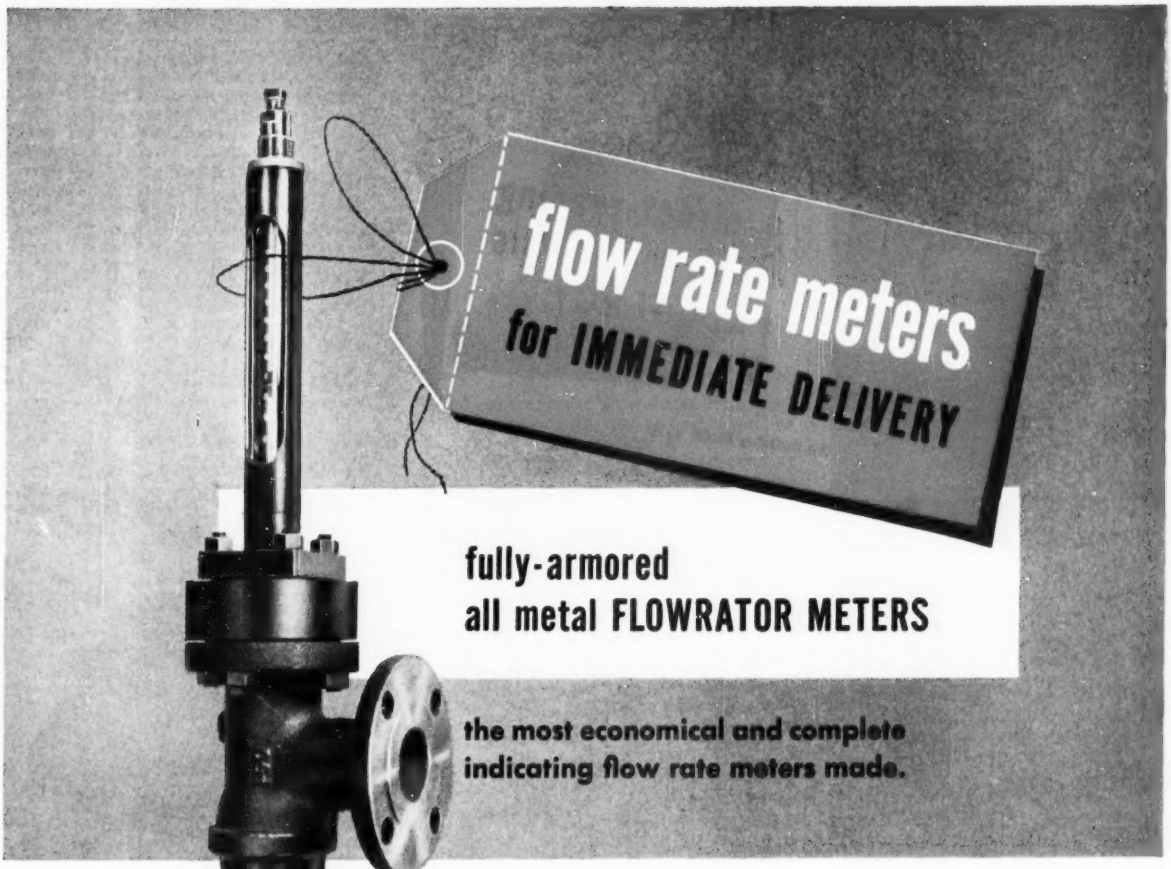
Mention No. 531 when filling out card.

Flow-rate Transmitter

New "Transaire" force-balance transmitter converts differential pressure into an equivalent 3-to-15 psig. output; can be used to measure fluid



flow, liquid level, or specific gravity. It has two basic units: (1) Differential-pressure-responsive primary, which consists of a two-part steel housing enclosing a Teflon-coated glass-fabric diaphragm, inner housing shaped to contour of diaphragm to permit over-range protection of 1500



flow rate meters for IMMEDIATE DELIVERY

fully-armored all metal FLOWRATOR METERS

the most economical and complete indicating flow rate meters made.

With Indicator Extension

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Delivery right from Fischer & Porter stock in Chicago, Dallas, Los Angeles and Hatboro means much to you.

Now you can have the wide range, linear scale Fig. 52 all-metal meter quickly, in 150-lb. and 300-lb. ratings in steel or 316 stainless. These meters are complete meters and not just metering elements, are low in price and may be equipped with Magnabond pneumatic transmitters or all-metal magnetic indicators which are regularly stocked.

Six sizes in FLOWRATOR Meters will cover a capacity range from a fraction of a GPM (of SCFM) to 240 GPM (or 850 SCFM). Each meter, with Stablvis float, has a viscosity immunity well above that found in orifice practice. Write for complete information including Variable Area Handbook.

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- Viscosity immunity
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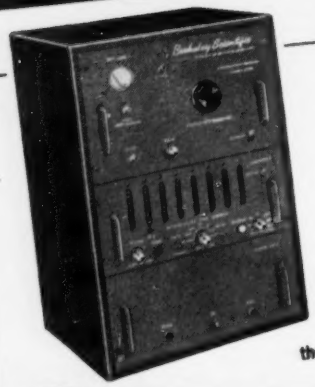

NOW

a direct-reading 0-42 megacycle FREQUENCY METER

the Berkeley Model 5570

description

Model 5570 is a single, compact instrument for rapid, precise measurement of frequencies from 0 cps to 42 mc. Basic sections are (1) a high-speed events-per-unit-time meter (EPUT), and (2) a heterodyne unit. Frequencies of 2 mc and below are applied directly to the EPUT and are read on the last six decade panels. From 2 to 42 mc, frequencies are applied to heterodyne unit and selector knob turned until output meter indicates the proper harmonic has been selected. External adjustment of crystal control unit to WWV is provided, to obtain an accuracy of 1 part in 10^7, ± 1 count.

applications

Rapid, accurate transmitter monitoring, crystal checking, general laboratory and production line frequency determination. Addition of a Berkeley Digital Recorder will provide an automatic printed record of the last 6 digits; ideal for plotting frequency drift or indicating stability.

specifications

RANGE:	0 cycle to 42 megacycles
ACCURACY:	± 1 count, ± crystal accuracy (short term: 1 part in 10^7)
POWER REQUIREMENTS:	117 volts, ± 10%, 60 cps, 260 watts
INPUT REQUIREMENTS:	Approximately 1 volt rms. (50 ohm impedance)
DISPLAY TIME:	1 to 5 seconds continuously variable
TIME BASE:	0.00002, 0.0002, 0.002, 0.02, 0.2 and 2 seconds
DIMENSIONS:	Approximately 32" high x 21" wide x 16" deep
PANELS:	Two 8¾" x 19"; one 12¼" x 19"
ACCESSORIES:	Available soon to extend range to 160 mc.
PRICE:	$1990.00, F.O.B. Richmond, California

Prices and Specifications subject to change without notice.

M-7

Please request Bulletin 604

Berkeley Scientific

division of BECKMAN INSTRUMENTS INC.

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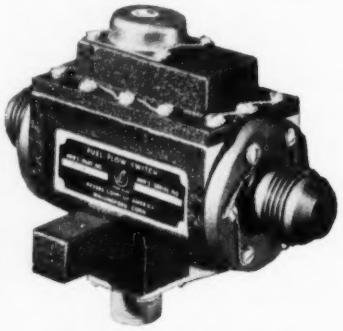
psi. to either side. (2) Secondary unit, incorporating a pneumatic force-balance transmitting system, enclosed by a gasketed cast-aluminum cover, self-purged to keep out corrosive vapors, dust, etc. Among features: (1) Simplified installation: two 1/2-in. pressure taps on both high and low pressure sides. (2) Design permits close coupling; in most cases metered fluid can be introduced into meter body. (3) Simple adjustments for range changing and zero. (4) Built-in damping device provides true average damping with pneumatic stability. —*Taylor Instrument Companies, Rochester* 1, *N. Y.*

Mention No. 532 when filling out card.

Flow Switch

New flow switch, for use in fuel pump lines, provides a warning signal whenever fluid flow falls below a predetermined value; is unaffected



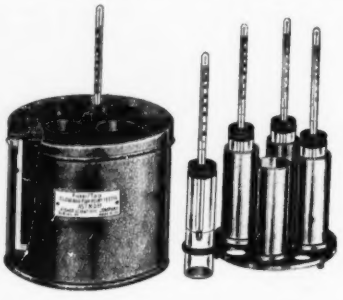
by pressure or temperature changes; resists vibration or acceleration forces. Actuating position can be set at factory.—*Dep't* 70, *Revere Corp. of America, Wallingford* 2, *Conn.*

Mention No. 533 when filling out card.

FOR THE TESTING DEPARTMENT

Cloud & Pour Point Tester

New "Fisher/Tag Improved Cloud & Pour Point Tester" meets specifications for ASTM test D97, is said to

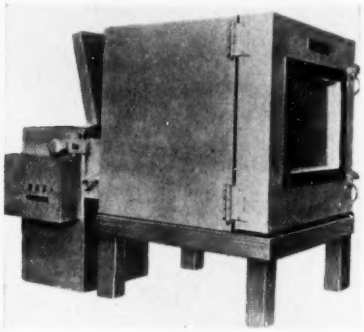


bring greater stability and convenience to performance of cold-weather oil tests. Among new features is enlarged opening for shaved ice or dry-ice.—*Fisher Scientific Co.*, 717 *Forbes St., Pittsburgh* 19, *Penna.*

Mention No. 534 when filling out card.

Temperature-test Chambers

New standard line of high and low-temperature environmental test equipment provides test conditions for majority of all temperature testing re-



quirements; permits purchasers to select chambers from existing specifications. Equipment comprises "Servo Unit" and "Companion Test Chamber," purchasable together or separately. An attachment maintains relative humidity from ambient to 95 percent in a temperature range from ambient to 180 F. "Servo Unit" is a portable 40-cfm. air conditioning unit which can absorb 1700 Btu/hr. at minus 100 F., or deliver 5000 Btu/hr. at 185 F., is available in two sizes. "Companion Chamber" is available in 3, 8 and 26 cu. ft. sizes; has a stainless steel liner and a door with a multi-pane inspection window. Optional equipment: electrical connector panel, turning shafts, coaxial cable, utility ports, and high-voltage.—*Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.*

Mention No. 535 when filling out card.

Comparison Bridge

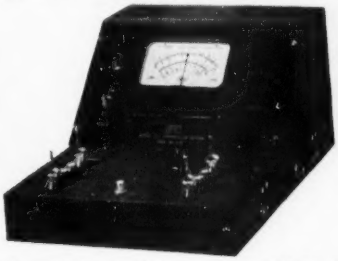
New "Type 1604-A Comparison Bridge" is self-contained, with a cathode-ray visual detector and an oscillator operating at either 1 kc. or 5

kc. Its basic accuracy is 0.1 percent. Its chief use is for rapid testing and sorting of resistors, capacitors and inductors over a wide impedance range (2 ohms to 20 megohms). It has two impedance-deviation ranges: plus-and-minus 5 percent, and plus-and-minus 20 percent. Dissipation-factor (or storage-factor) differences are also indicated.—*General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.*

Mention No. 536 when filling out card.

Comparison Bridge

New "Model E-1 Comparison Bridge," for production-line tests of resistors, capacitors, and audiofrequency inductances, features simpli-

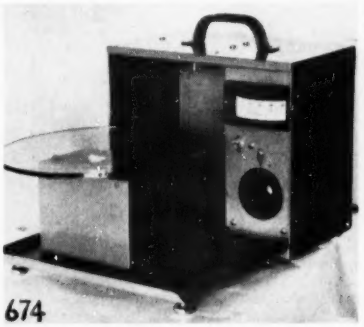


fied controls and five scales which allow components to be matched or compared with standards within limits of 1, 2.5, 5, 10, and 25 percent at full-scale deflection. The 1-percent scale may be read accurately to indicate differences between components as small as 0.1 percent. Components with impedances from 1 ohm to 5 megohms at 60 cps. may be compared.—*Southwestern Industrial Electronics Co., Houston 19, Texas.*

Mention No. 537 when filling out card.

TV-tube Reflectometer

New photoelectric reflectometer of fixed 35-degree angle was specifically designed for measuring reflectance of

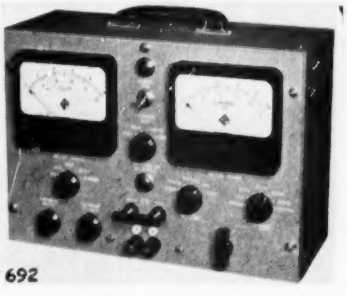


frosted face-plates of picture tubes; gives more significant results than did either 20-deg. or 45-deg. glossmeters; has been approved by R & TV Mfrs. Assn.—*Henry A. Gardner Lab., Bethesda 14, Md.*

Mention No. 538 when filling out card.

Diode Tester

New "Model DT-100 Diode Tester," for measuring static characteristics of germanium and low-power selenium diodes, has separate forward and reverse power supplies with continuously-variable outputs or preset



Do you need

A RELIABLE AND CONVENIENT MEANS FOR CHECKING BOTH LEAKAGE AND CONTINUITY OF ELECTRICAL COMPONENTS?

SIE

MODEL C-3 RESISTANCE METER IS YOUR ANSWER

The Model C-3 Resistance Meter is designed for use by manufacturers in checking both leakage and continuity of electrical components. It is particularly valuable for making rapid checks of the insulation resistance of transformer windings, condensers and electrical wiring, as well as measuring the ohmic value of resistors and windings.

ELECTRICAL SPECIFICATIONS

ACCURACY: Plus or minus 3% of full scale deflection plus 1 ohm on the OHMS ranges.

Plus or minus 3% of full scale deflection (approximately 3 degrees) on the MEGOHMS ranges except 10 megohm range.

Plus or minus 5% of full scale deflection on 10 megohms range.

RANGES: 1 ohm to 1 million megohms

The ohmmeter applies a maximum of 1½ volts to the resistor under test. It has a scale of from 0 to 500 ohms and a selector switch for selecting scale multipliers of x 1, x 10, x 10², and x 10³.

The leakage tester applies a maximum of 150 volts to the unit under test. Its scale reads from 1 to 100 megohms and has multipliers of x .1, x 1, x 10, x 10², x 10³, and x 10⁴.

SOUTHWESTERN INDUSTRIAL ELECTRONICS COMPANY

regulated reverse potentials. Three-position spring-return switch allows rapid transfer from forward to reverse test positions and returning to neutral. Automatic overload circuit detects shorted or reversed diodes and indicates this condition by a lamp while limiting current to a safe value. An oven (accessory) permits testing diodes at elevated temperatures.—*Dep't I, Teletronics Laboratory, Inc.*, 54 *Kinkel St., Westbury, N. Y.*

Mention No. 539 when filling out card.

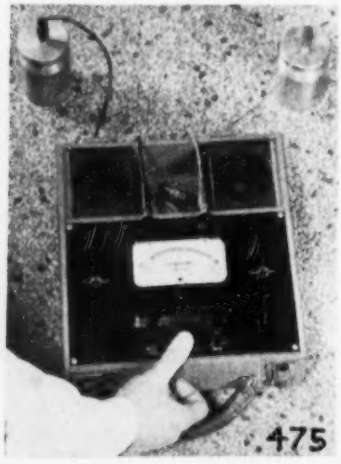
Porosity Detector

New "Type PR" porosity detector signals and/or indicates minute holes in electrically non-conducting materials up to 0.04-in. thick, is available in two laboratory models and various continuous quality-control models (latter with two rollers each for permanent installation on production lines). Features are safety to operators, adjustability, short response time and prevention of damage to material. Optional for factory models: automatic marker (harmless crayon, etc.), electric counter, audible or visual signals, etc.—*Viking Instruments, Inc., East Haddam, Conn.*

Mention No. 540 when filling out card.

Conductive-material Tester

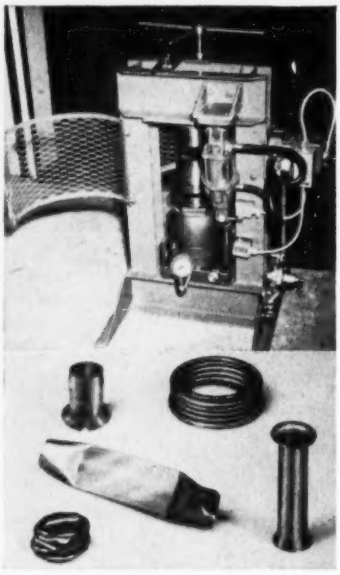
New "Model 269 Vibrotest" meets latest National Fire Protection Association recommendations for electrical resistance tests of conductive materials; is suitable for use on floors, furniture, personnel, etc., in hospital and other rooms where hazardous atmospheres or chemicals require prevention of static-electricity discharges. It has two color-coded scales (for conductive-material tests, and for personnel and conductive-shoe tests). Two ten-foot leads for use with five-pound floor electrodes or for connection to other apparatus. Battery life approx. nine months in normal use.—*Associated Research, Inc.*, 3767 *W. Belmont Ave., Chicago* 18, *Ill.*



Mention No. 541 when filling out card.

Tubing Test Stand

New pneumatically- and hydraulically-actuated automatic test stand for determining physical characteristics of seamed tubing up to 3-in. diam. can check steel, stainless steel, and carbon-steel tubing specimens for flaring, column and crushing strength with pressures up to 100,000 psi. It is self-contained, has push-button control, hinged safety guard, and only requires connection to 60-80 psi. air supply.—*The Dommers Co.*, 428 *S. Cherry St., Wallingford, Conn.*



Mention No. 542 when filling out card.

Battery-powered UV Lamp

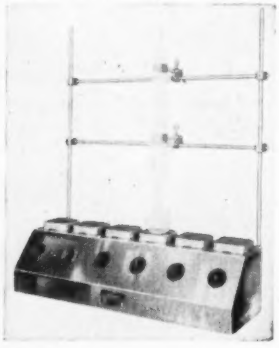
New "Mineralight M-12" is said to be the only self-contained ultraviolet lamp on the market operating on 110-volt a-c. derived from one 6-volt battery. It has a built-in flashlight with a 2-way switch for either white or ultraviolet light. Tube is of pure fused quartz; will burn for 1500 or more hours.—*The Radiac Co.*, 489 *Fifth Ave., New York* 17, *N. Y.*

Mention No. 543 when filling out card.

FOR THE LABORATORY

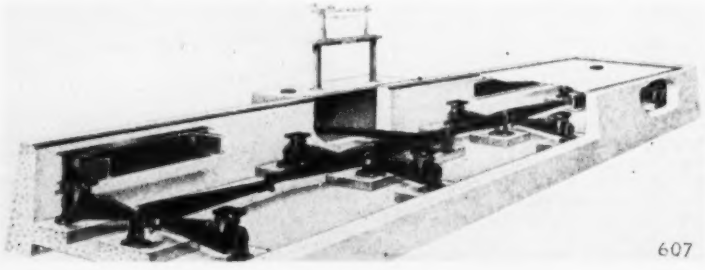
Six-unit Extraction Rack

New "No. 5000" 6-unit extraction rack for extractions, evaporations



Motor Truck Scales

New "Four-Section Straight Lever Motor Truck Scales" utilize a new lever design to obtain optimum strength with least weight. Maker's ball-bearing feature has been retained and adapted to save wear on knife edges and bearings. Capacity is 50 tons. Platform sizes are 45, 50 or 60 feet long by 10 feet wide. Seven types of weight indicators are available, including new "Howe Teleprint Electronic Remote Weight Recorder."—*The Howe Scale Co., Rutland, Vt.*



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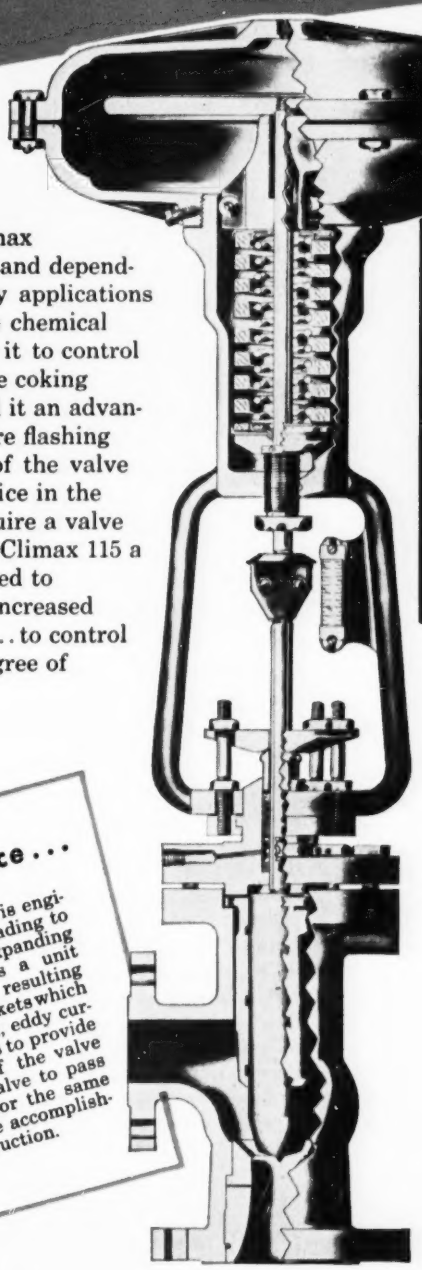
a NEW BS&B Climax Control

Designed For *TOUGH* Service in The Process And Power Industries



NOW... a new valve in the Climax family of precision built controls and dependable performers. There are many applications for this angle type valve 115. The chemical and refining industries will want it to control residual oils or liquids which have coking properties. Power plants will find it an advantage for high pressure drops where flashing occurs in the downstream side of the valve piping. Where tough, severe service in the process and power industries require a valve that will "take it", you'll find the Climax 115 a valve that will "do it". It's designed to control gases requiring greatly increased volume upon release of pressure... to control liquids that are subjected to a degree of flashing that would render an expanded outlet necessary.

For minimum turbulence...

The valve body of the Climax 115 is engineered with a sweep flow inlet leading to a venturi throated valve seat expanding into the outlet...all designed as a unit for minimum turbulence. The resulting streamlined flow eliminates pockets which are the cause of flow reversal, eddy currents and erosion. It also tends to provide a maximum port efficiency of the valve which, in turn, allows the valve to pass greater quantities of fluid for the same diameter port than would be accomplished in a globe type of construction.

BS&B Climax Type 115*

Expanded Outlet Diaphragm Control Valve

***115-D— Air to close valve...opens with air supply failure**

115-DRT—Air to open valve...closes with air supply failure

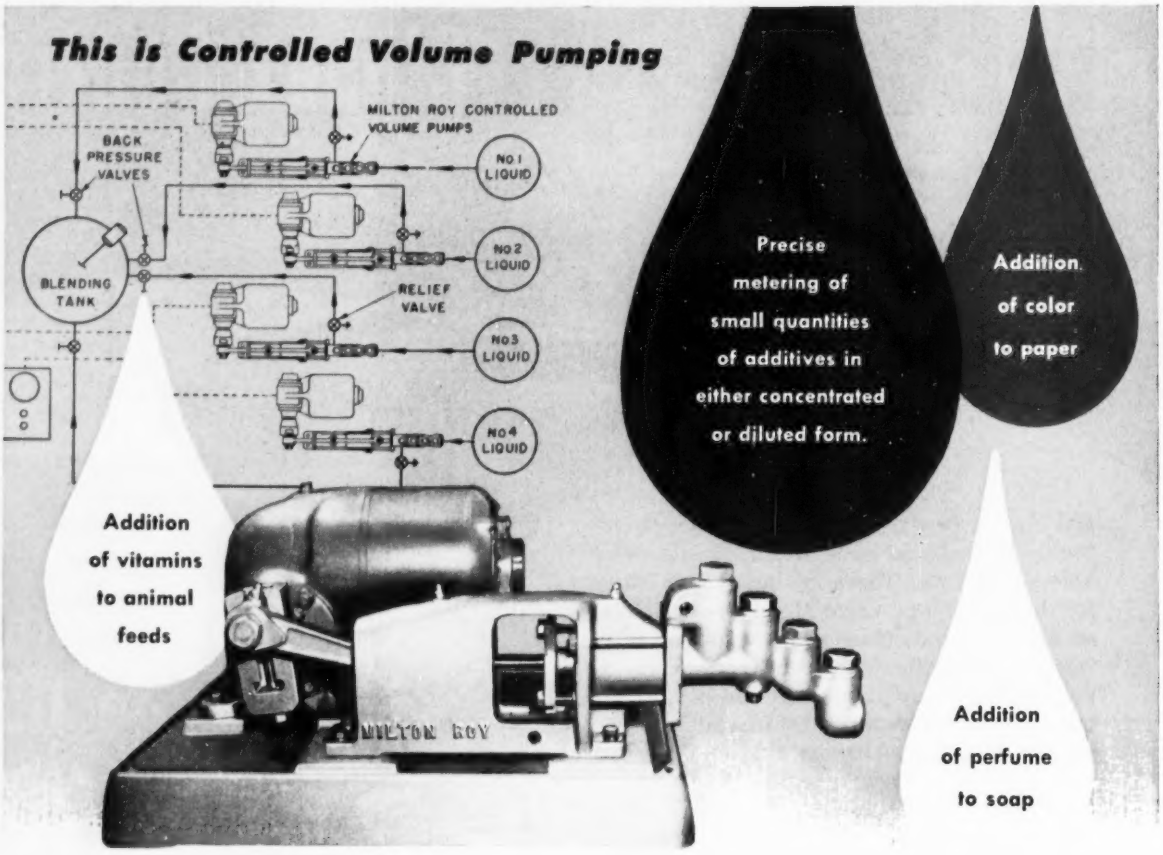
The diaphragm motor mechanism in the Type 115 Climax is the same used in all Climax Type 86 Control Valves, selected for the particular service required. Pressure balanced top works can also be supplied. Type 115 is furnished with carbon steel angle type bodies in expanded outlet sizes—2" x 3" ...3" x 4"...and 4" x 6" with standard 150#, 300#, and 600# ASA flanges.

CLIMAX BS&B CONTROLS

BLACK, SIVALLS & BRYSON, INC.

CLIMAX CONTROLS DIVISION, DEPT. 4-V4

7500 East 12th St. Kansas City 3, Missouri


This is Controlled Volume Pumping
MILTON ROY CONTROLLED VOLUME PUMPS
BACK PRESSURE VALVES
BLENDING TANK
RELIEF VALVE
NO.1 LIQUID
NO.2 LIQUID
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Precise metering of small quantities of additives in either concentrated or diluted form.
Addition of color to paper
Addition of vitamins to animal feeds
Addition of perfume to soap
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MILTON ROY CONTROLLED VOLUME PUMPS DO THE JOB

Wherever processes require the addition of liquids in either concentrated or diluted form, Milton Roy Controlled Volume Pumps have ideal application. Among the diversified industries where they are used for this purpose are food and food processing, pulp and paper, soap, pharmaceuticals, cosmetics, petroleum and petrochemicals, textiles and fibres, and brewing.

Continuous controlled volume feeding results in uniform blending of additive with basic product, assures rigid consistency of mixture or color among successive batches. Costly variations in content are avoided by holding delivery accuracy of the additives within a fraction of one per cent for most applications.

Wherever precision liquid component addition or blending is encountered in industry, Milton Roy equipment spells out marked returns in accuracy, efficiency and economy. As air-powered or motor-driven units, as components of automatic systems complete with a variety of automatic controls and accessory equipment, Milton Roy Controlled Volume Pumps give an assured accuracy and uniformity of product often impossible to obtain by any other method. Necessary changes in formulae can be accomplished quickly and accurately by manual or automatic adjustment of controls.

Capacities range from 3 milliliters per hour to about 50 gallons per minute, against pressures up to 25,000 pounds per square inch. Practically any liquid—slurries, suspension of solids, viscous or corrosive chemicals, tars, sludges—can be handled with equally precise efficiency.

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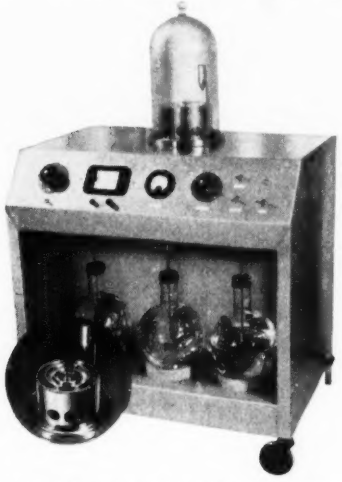
and distillations, features polished 18-8 stainless steel case, cast aluminum hot plates, special Ohmite rheostat, extruded aluminum support rods, ventilated case and large area base to prevent tipping.—*Labline Inc., 217 N. Desplaines St., Chicago 6, Ill.*

Mention No. 545 when filling out card.

Cyclic Molecular Still

New cyclic type molecular still is for distilling at high vacuum without damage to molecular structure: materials whose molecular weights are



above 250, also materials of extreme heat sensitivity such as some of the vinyl polymers. Either a concentrated residue or a derived distillate may be obtained. Preliminary passes can be made to remove water, air, and high or low boiling-point fractions.—*American Instrument Co., Inc., Silver Spring, Maryland.*

Mention No. 546 when filling out card.

Heavy Liquids for Specific Gravity Determinations

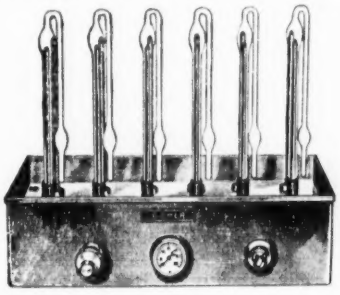
New series of liquids and suspensions covers range from 1.48 to 7.5 for sink-or-float specific gravity tests of minerals, etc.; consists of seven

transparent liquids (1.48 to 3.3) and nine opaque suspensions (3.6 to 7.5), each in 15-ml. volume in a wide-mouth bottle, and a spoon-stirrer (illustrated). Also announced is "Liquid 3.52" for identifying genuine diamonds.—*R. P. Cargille Labs, 117 Liberty St., New York 6, N. Y.*

Mention No. 547 when filling out card.

Dryer for Viscometers Semi-automatic Washer and

New "Fisher-Tag Viscometer Cleaning and Drying Apparatus" has six capillary tubes, six draining pins, solvent tank, air and solvent filters, pressure gage and regulator, and copper-

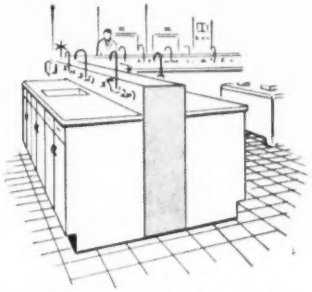


tubing connections for attaching solvent tank; is also available without solvent tank. Used viscometers are placed over capillary tubes, are sprayed with selected solvent and dried with air.—*Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Penna.*

Mention No. 548 when filling out card.

Filler-panel for Back-to-back Benches

New one-piece "Island Filler-Panel" covers open end of any "Unitized"



"island" or "Peninsula" assembly, concealing pipes and conduits required to service modern laboratory bench.—*Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.*

Mention No. 549 when filling out card.

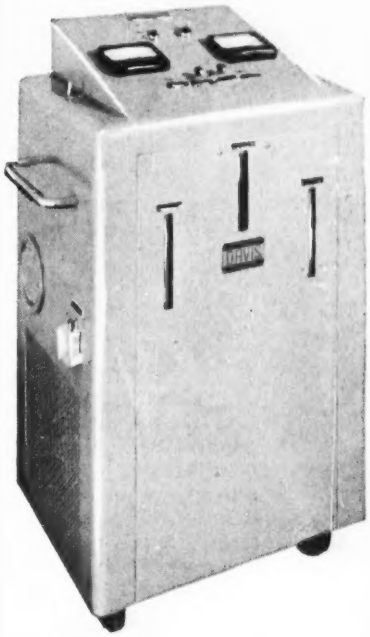
Mercury Recovery System

New "Mer-Vac" equipment for recovering mercury globules and mercury-laden dusts, and of combating hazards of mercury vapor poisoning combines an enlarged gas mask canister for mercury vapor collection and

DAVIS

semi-portable

Electro-Conductivity Gas Analyzer



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- **Water reservoir, flow meters, ion exchange chamber and pyrolyzing furnace**

A precision instrument in a semi-portable housing — developed to meet the requirements of industry for quick, accurate on-the-spot gas analysis of chlorinated hydrocarbons, CL_2, H_2S, SO_2, NO_2 (nitrous fumes) etc. in the toxic ranges. Operates on the principle of differential measurement of conductivity of distilled water before and after gas sample has passed. Continuous recording models are available for permanent installation.

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Low Temperature - General Purpose

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Type LT-840
Low temperature Xactemp Pyrometer with rigid extension arm and surface tip thermocouple.

1001 USES

This is the answer to quick, accurate temperature readings below 800° F. in many industrial processes and operations. And it's so convenient to handle.

The Xactemp hand-type pyrometer, Model LT-840, is used with needle thermocouples, ribbon thermocouple, surface tip thermocouple, and other specially designed thermocouples and extension arms. These are easily interchangeable and, without adjustments or recalibration of the instrument, quickly ready it for measuring the surface temperature of stationary and revolving rolls and cylinders, flat and irregular surfaces of molds, dies, etc. in rubber and paper making, plastic materials, rubber, wax, oils, greases, and other semifluid materials.

Handy, compact design makes this Xactemp pyrometer ideal for field service, laboratory, and production-line use.

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NEW INSTRUMENTS

a powerful industrial vacuum cleaner for mercury recovery. Features: synchronous timer indicating when canister contents must be replaced; air circulation system for motor preventing amalgamation of wiring connections and parts; glass trap for mercury recovery; stainless steel and porcelain enameled canister parts; acid-resistant dust filter.—*Acme Protection Equipment Co.*, 3037 *W. Lake St., Chicago* 12, *Ill.*

Mention No. 550 when filling out card.

Laboratory Pressure and Vacuum Controller

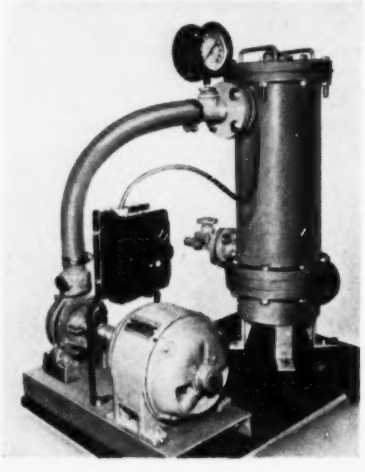
New "No. 7A" all-glass "Manostat" is identical to "No. 7," except for 3-way stopcock at base, required only in special cases such as flow control.

Both models are designed for automatic vacuum and pressure control in laboratory.—*The Emil Greiner Co.*, 20-26 *N. Moore St., New York* 13, *N. Y.*

Mention No. 551 when filling out card.

Filter Pumps

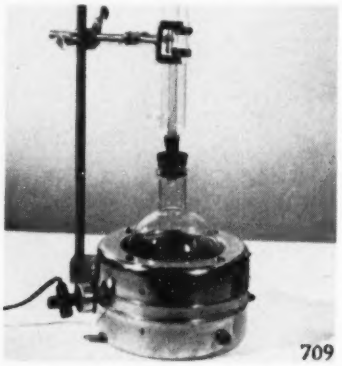
New "Models RLS-1200 and RLS-2400" filter pumps are designed and constructed to produce sparkling clear filtration of practically any acid or alkaline solution from pH 1 to pH 14; are rated at 1000-1500 and 2000-2500 gph. respectively. Automatic controls include magnetic starter, stainless steel pressure switch and stainless Bourdon gage. Setup is such that motor stops automatically when filter assembly becomes loaded with impurities.—*Dep't 1, Sethco*, 70-78 *Willoughby St., Brooklyn* 1, *N. Y.*



Mention No. 552 when filling out card.

Heating Mantle

New all-metal-armored safe-type heating mantle provides versatility for clamp arrangements. Heater can support reflex column; same clamp

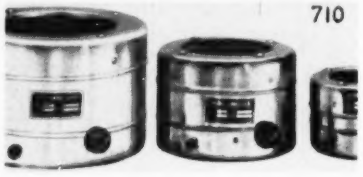


can support heater in lattice framework. Interior of mantle all high-temperature materials. Soft metal cloth distributes heat to flask. Mantles can be plugged into line without safety devices for protection against burnouts.—*The Forma-Heater Co.*, 804 *Warren St., Marietta, Ohio.*

Mention No. 553 when filling out card.

Constant-temperature Heating Mantles

New type of heating mantle has built-in thermoregulator which is



sealed, snap action, hazard safe and imbedded in dense insulation. Available sizes from 250-ml. to 22-l.—*The Forma-Heater Co.*, 804 *Warren St., Marietta, Ohio.*

Mention No. 554 when filling out card.

Swinging-bucket Ultracentrifuge Rotor

New "Type SW 39 Spinco" swinging-bucket rotor permits three separate 5.5-cc. samples of material to be ultracentrifuged up to 178,435 *G* at a maximum speed of 39,460 rpm. Sedimentation conditions approach those in a conventional sectoral analytical cell, providing minimum reorientation of boundaries upon deceleration to rest. This makes new rotor applicable for sampling of material in preparation for subsequent biological or chemical assay. A plastic stand is supplied to facilitate attachment and

removal of buckets outside operating chamber of the ultracentrifuge. Each bucket is arranged to hold a ½-in. diam. by 2-in. long plastic tube; can accommodate special quartz tubes where an absorption analysis of sample is required.—*Specialized Instruments Corp., 655 O'Neill Ave., Belmont, Calif.*

Mention No. 555 when filling out card.

Combined Neutron and Gamma Ray Dosimeter

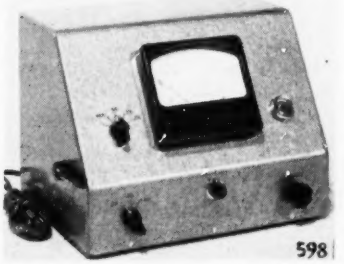
New "Model L-29" (direct-reading) and "Model Y-69" (pocket chamber) give a combined reading for slow and thermal neutrons and for x and gamma rays. Full-scale reading for x and gamma rays is 200 mr.; for slow

and thermal neutrons it represents same potential damage to body, namely 200 mr. equivalent physical. Hence, no need to wear a separate gamma- or neutron-sensitive dosimeter.—*Landsverk Electrometer Co., 550 W. Garfield Ave., Glendale 4, Calif.*

Mention No. 555-2 when filling out card.

Charger-reader

New "Model L-62" a-c.-operated charger-reader accepts four ranges of pocket chambers; has circuit so arranged that reading on a chamber is not lost if selector switch is acci-



dentally set to wrong range. Scale is 4 in. long; marked 0 to 50 and 0 to 200; linear to 2 percent.—*Landsverk Electrometer Co., 550 W. Garfield Ave., Glendale 4, Calif.*

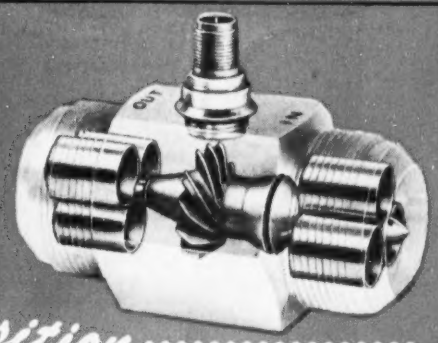
Mention No. 555-3 when filling out card.

Potter OFFERS A NEW WAY TO MEASURE Flow

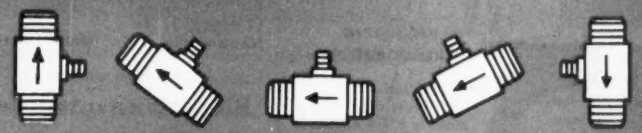
LINEAR • ACCURATE WITHIN ½% • EASILY INSTALLED • OPERATES TO 35,000 PSI

HANDLES ACIDS, CAUSTICS, SUSPENSIONS AT HIGH OR LOW TEMPERATURES

You Install This POTTER SENSING ELEMENT



In Any Position



With

POTTER *gives you these* FEATURES:

The Potter Flow Sensing Element is inherently linear and is accurate within ±½% over the recommended range. It can be built of any non-magnetic materials for resistance to acids, caustics and corrosive materials.

The element will operate at extreme pressures—as high as 35,000 psi; and is quickly and easily installed in any size or type of piping...vertically, horizontally or at an angle.

Rangeability is as high as 20-to-1, while the pressure drop through the unit is usually less than 6 psi at maximum flow. The temperature range over which the system will operate is −450° to +1200°F. Flow is measured in either weight or volume units.

Instruments available include rate indicators, various types of recorders incorporating electric or pneumatic control forms, or both, for ratio or mixing control. High accuracy is obtained with totalizing systems, which can be supplied to automatically start and stop flow from as many as three separate sources for batch mixing applications.

WRITE FOR INFORMATION to learn how this new method of measuring flow can be used to solve your metering problems.

POTTER AERONAUTICAL CO. 87 Academy St., Newark, N.J.

PALMER

MERCURY ACTUATED

Temperature Indicating Instruments

4½" DIAL THERMOMETERS

Made in 3 types to suit any requirements. Rigid stem, wall or flush mounted, 11 inches of scale reading. Interchangeable with standard industrial separable sockets. Stem can be placed at any angle and case can be rotated to any readable position.

RECORDING THERMOMETERS

Twelve inch die-cast aluminum case with black or white wrinkle or satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 +950°F or Equivalent in °C.

INDUSTRIAL THERMOMETERS

Red-Reading Mercury —Extruded brass case — chrome finish. Ranges —40 + 950°F or Equivalent in °C.

RED-READING MERCURY LABORATORY THERMOMETERS

Thoroughly annealed for permanent accuracy. Complete line A.S.T.M. and fractional division types.

FOR COMPLETE INFORMATION WRITE FOR CATALOG 200 C

PALMER

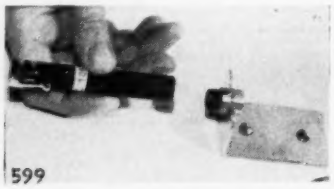
THERMOMETERS, INC.

Cincinnati 12, Ohio • MElrose 1500

NEW INSTRUMENTS

Dosimeter-cap Remover

New pocket chamber dust cap remover is a time-saver. Only one hand



is required to remove dust cap, charge or read dosimeter and replace dust cap.—*Landsverk Electrometer Co., 550 W. Garfield Ave., Glendale 4, Calif.*

Mention No. 555-4 when filling out card.

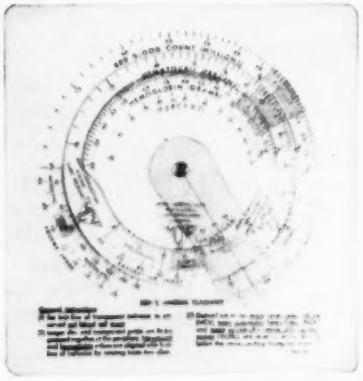
Sample Spinner

New sample spinner expedites preparation of samples from slurries or low-particulate dispersions in solution; simplifies uniform sample spreading. Turntable speed is 20 rpm. —*Dep't FP-2, Radiation Counter Labs, 5122 W. Grove St., Skokie (Chicago), Ill.*

Mention No. 555-5 when filling out card.

Blood-constants Calculator

New "Best Anemia Classifier" for classifying the anemias is a circular slide rule on which red blood count, hematocrit, and hemoglobin are lined



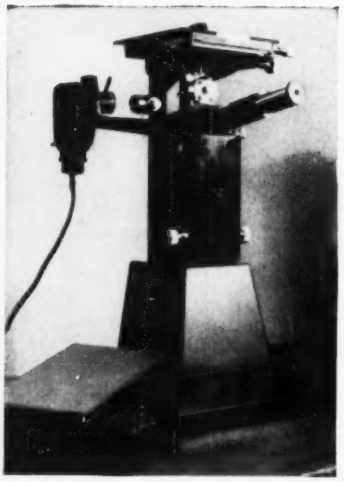
up with a rule on indicator, after which all of the constants are read directly.—*Clay-Adams Co., Inc., 141 E. 25th Street, New York 10, N. Y.*

Mention No. 556 when filling out card.

MICROSCOPES

Metallurgical Microscope

New "Melabor" imported inverted metallurgical microscope for bright and dark ground visual observation of metallic specimens has large base with shock absorbers. When placed on stage, specimen is automatically aligned perpendicularly to optical axis. 15-cm. square mechanical stage traverses in two directions with scales

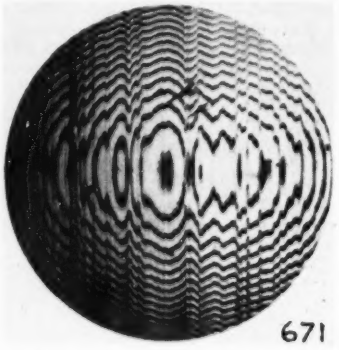


and verniers. Optics for magnifications from 40 to 2200 times. Accessories include binocular eyepiece attachment, micro hardness tester, etc. —*William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.*

Mention No. 557 when filling out card.

Interference Equipment for Metallographs

New interference equipment, for examination of surface finish, can be



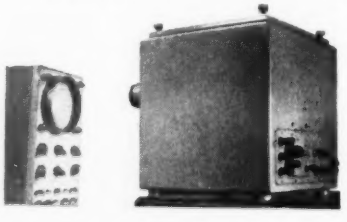
furnished as adjunct to "Reichert" metallurgical camera-microscopes. Photo shows interference pattern of a ball-bearing race.—*William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.*

Mention No. 558 when filling out card.

CAMERAS

Universal CRO Camera

New "M.731 Universal Recording Camera" provides all three types of oscilloscope photographic recording: still, drum, and continuously-moving-



film; uses 35mm. or 70mm. film or paper, perforated or unperforated. Drum speeds, 4 to 1200 in./sec.; moving-film speeds, 0.4 to 100 in./sec.; mechanisms quickly interchanged. Slow-speed attachment reduces film speed to 0.01 in./sec. Standard lens is 3-in. f/1.9; others available.—*Photographic Instrumentation Div., J. A. Maurer, Inc.*, 37-01 31*st St., Long Island City* 1, *N. Y.*

Mention No. 559 when filling out card.

High-speed Sequence Camera

New "Hulcher 70" camera takes pictures on 70mm. film at rates up to twenty-five 5 in. frames or fifty 2½ in. frames per second. Design over-

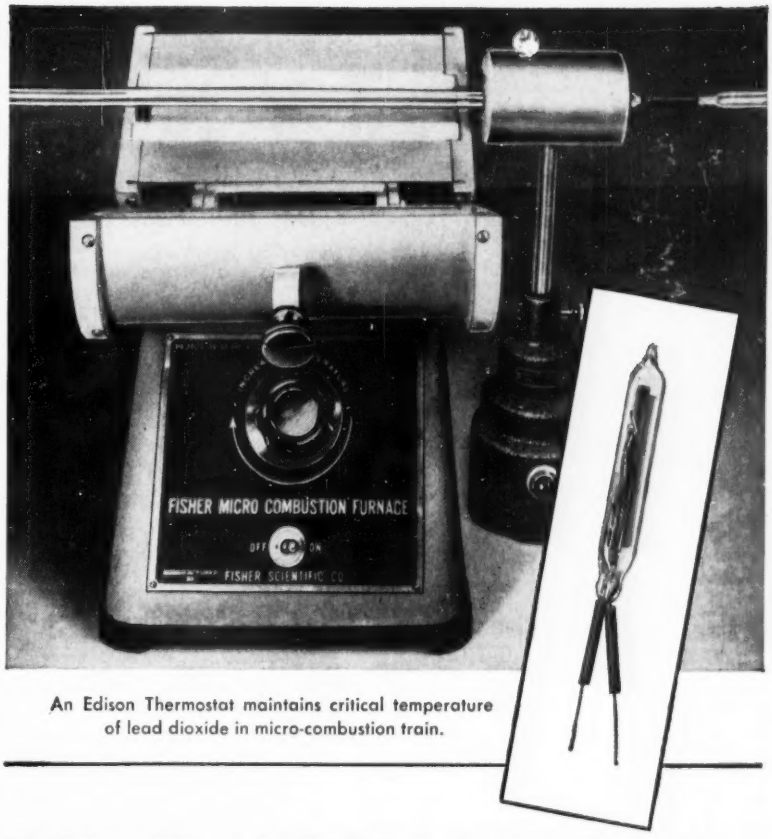
comes difficulties involved in film-transport and shutter systems, contains no reciprocating parts. Double-disk focal-plane shutter provides high motion-arresting characteristics. Camera is equipped with reflex focusing, variable frame speed control and electric braking. Frame size may be changed in two minutes. Camera weighs about 32 lbs. and uses standard 70mm. perforated film in 100-foot daylight-loading spools.—*Charles A. Hulcher Co., Inc.*, 40 *Manteo Ave., Hampton, Va.*

Mention No. 560 when filling out card.

Recording Camera

New "Auto Camera Mark 3" recording camera is available with accessories for time-lapse recording, photomicrography, normal and stereo

photomacrography, aircraft instrument recording, etc., at speeds as fast as 4 pictures per second or at intervals from ¼ sec. to as long as desired. Spring motor provides exposure of 21 ft. of 35-mm. film. Both exposure and film transport functions are effected by single electrical pulse. Operating voltage is 12 or 24 v. dc.; five shutter speeds from 1/10 second to 1/200 second, and "time" exposure. Standard lens is 36-mm. focal length, f/3.5;



An Edison Thermostat maintains critical temperature of lead dioxide in micro-combustion train.

Making Chemicals React Better through

Precision Temperature Control

This Fisher Scientific Micro-Thermostatic Sleeve and Micro-Combustion Furnace is used in the gasometric analysis of nitrogen-containing compounds for the determination of carbon and hydrogen.

The gasses in the combustion tube are passed over granulated lead dioxide in the thermostatic sleeve to assure the removal of nitric oxides, thus preventing their absorption by the CO_2. Lead dioxide absorbs the oxides of nitrogen more rapidly at 180°C, but above this temperature oxygen begins to be liberated. An Edison thermostat was selected for this application because an accurate and constant temperature control must be maintained to assure the complete removal of all nitrogen oxides. Optimum temperature conditions are assured by the thermostat's sealed-in-glass construction and tamper-proof design. A neutral arc-quenching atmosphere preserves the contacts from wear, dust, corrosion or handling.

The exact duplication of results from assay to assay is made possible by the permanence of the thermostat's control setting. This remains constant over years of service during which the contacts may operate thousands of times or, as in many protective devices, not at all.

Because Edison Thermostats are engineered for each application to meet your particular operating requirements, you are assured that the optimum life, stability and tolerance has been built into your thermostat.

Thomas A Edison
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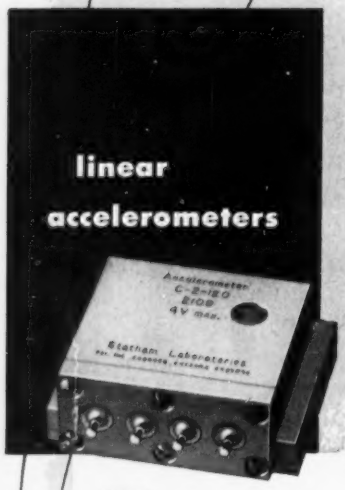
EDISON INSTRUMENTS

YOU CAN ALWAYS RELY ON EDISON



Linear accelerometers are manufactured by Statham Laboratories for measurement in ranges from ±0.5g to ±1,000g. Unbonded strain gage accelerometers have higher natural frequency than is usually attainable with other types of pickoffs. For maximum possible output, the mechanical construction of these instruments is such that movement of the suspended mass produces a change of resistance of all four arms of the complete balanced bridge. The resistive nature of the bridge permits the use of these accelerometers in either A.C. or D.C. circuits.

Please request Bulletin No. 4.0.

Statham
LABORATORIES
• Los Angeles 64, Calif.

others available. Two models available: "Mark 3 A" provides 200 pictures 1 in. x 1 in.; and "Mark 3 B," 300 pictures 3/4 in. x 1 in.—*J. A. Maurer, Inc.*, 37-01 31*st St., Long Island City* 1, *N. Y.*

Mention No. 561 when filling out card.

Dry Photocopy Unit

New "Exact-Phote-Copy" dry processing unit combines a printer with processing unit, turns out dry copies; eliminates washing, fixing, drying and darkroom; copies anything typed, written, printed or drawn; produces 60 to 90 copies per hour at a cost of 8c each for letter size; operates on 110 v.ac.; accommodates paper 12 in. wide by any length.—*General Photo Products Co., Inc., Chatham, N. J.*

Mention No. 562 when filling out card.

Camera Intervalometer

New "Model N10 Intervalometer" controls cyclic rate of camera recording devices, etc. Pulse rates per second are 1, 2, 4, 5, 8, and 10; pulse

length is variable from 25 to 70 milliseconds. (Special intervals and durations to order.) Instrument requires little or no maintenance. Wherever possible, AN Standard components have been incorporated. Motor is a chronometrically-governed type with 0.5 percent speed regulation; completely shielded and filtered to eliminate radio interference. Intervalometer is insensitive to operating position; withstands 15-G loads in any direction and temperatures from minus 50 F. to plus 150 F.—*Photographic Products Inc.*, 6916 *Romaine St., Hollywood* 38, *Calif.*

Mention No. 563 when filling out card.

Mobile Copy Camera

New "Tupper-Peerless Copy Camera" is daylight-loading dual-purpose mobile camera which makes a permanent record of up to 720 documents or

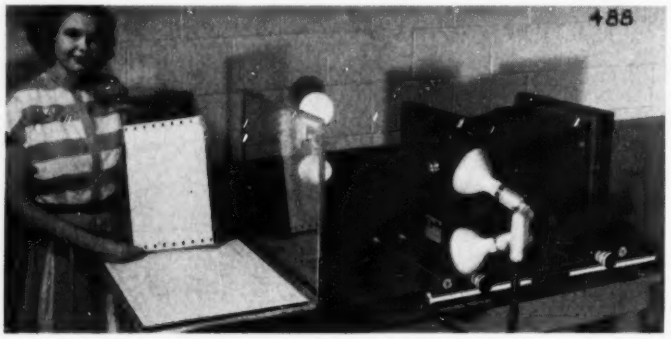
cards per hour on continuous roll of photocopy paper. Photographs one side of letters and documents (8½ x 11 in. up to 8½ x 14 in.) and both sides of file cards (5 x 8 in.), together with a 1 x 8 in. identification strip. Cycle of operation takes 5 seconds. Exposed paper can be removed in daylight and may be cut at any point. —*Peerless Photo Products, Inc., Shoreham, L. I., N. Y.*

Mention No. 564 when filling out card.

Xerography-process Camera

New "No. 3 XeroX" camera reduces or enlarges drawings or other subjects by xerography process directly on to an 8½ x 13 in. "XeroX" plate. To make an exposure, operator places copy on 17 x 22 in. tilting copy board. Board is brought into exposure position to camera, in which an electrostatically charged "XeroX" plate has been placed. After exposure, plate is removed from camera and processed in "XeroX" Copier. Image is transferred to an offset paper master or to a translucent (engineering) paper and image made permanent by a few seconds' fusing.—*The Haloid Co.*, 2-20 *Haloid St., Rochester* 3, *N. Y.*

Mention No. 565 when filling out card.



ELECTRICAL INSTRUMENTS

Plug-in Instruments

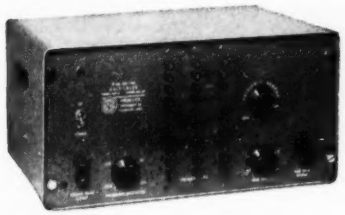
New plug-in feature permits maker's electrical indicating instruments to be pulled out and replaced by hand in a few seconds. Instruments are

available in a full range of standard calibrations (special calibrations to meet early delivery dates); 3-inch size in either round or rectangular cases; 4-inch size in rectangular case. Also available are new plug-in receptacles.—*Cole Instrument Co.*, 1320 *S. Grand Ave., Los Angeles* 15, *Calif.*

Mention No. 566 when filling out card.

Quickly-set Oscillator for Frequency Measurements

New "Model 440-A Push-Button Oscillator" produces sine waves and square waves at any frequency between 0.01 cps. and 100 kc. For fine



control of frequency it has three banks of ten push-button switches and an additional vernier which varies frequency continuously within increment between adjacent buttons of third switch bank. Hum and distortion are attenuated when setting of calibrated logarithmic output level control is reduced and are thus maintained at a constant low percentage of desired output signal.—*Krohn-Hite Instrument Co.*, 580 *Massachusetts Ave., Cambridge, Mass.*

Mention No. 567 when filling out card.

Audio Oscillator

New "Model 510-B" wide-range audio oscillator features improvements in stability and precision. Frequency changes less than 0.5 percent with line-voltage variations from 95 to 130 volts, and less than 1 percent with temperature variations of zero to 150 F. Standard calibration accuracy is 2 percent (1 percent on special order). Frequency range 18 cps. to 1.2 Mc.; distortion under 0.2 percent

Largest assortment of sizes and mounting styles to match equipment requirements

MECHANICALLY

Widest range of types to match exacting circuit requirements

ELECTRICALLY

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5,348 TYPES

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POTENTIOMETERS

precision
IN MINIATURE SIZE

Electro-Mec Laboratory specializes in potentiometers of extreme accuracy, low torque*, and small size, engineered for each individual application. Close coordination between engineering and manufacturing provides laboratory quality and performance in production quantities, one or a thousand.

The "know-how" and facilities are also available for the solution of non-standard potentiometer design problems. For more information please write or telephone the Engineering Department. HAnover 2-3155

*** Torque in the range of .003 to .100 oz. in., Resolution to 1300 turns of wire per inch, Linearity to .1%.**

Type 1395

"G" stability and Minimum Torque. High resolution and Linearity. Resistances 20 to 200,000 ohms.

Type 1396

Servo Mounting. Ultra-low torque. Maximum accuracy in Minimum size.

Type 1418

Computer accuracy and Highest Resolution Low torque of .025 oz. in.

ELECTRO-MEC LABORATORY

19 MURRAY STREET NEW YORK 7, N. Y.

over most of useful range: constant output within 0.5 db.—*Waveforms, Inc., 333 Sixth Avenue, New York 14, N. Y.*

Mention No. 568 when filling out card.

Wheatstone Bridge

New "Model 6100" fault location Wheatstone bridge for general laboratory use or field servicing of communications systems weighs 8 lbs.;

measures resistance between 1 and 1,011,000 ohms to an accuracy of 0.1 percent plus or minus 0.01 ohm; quickly locates grounds, crosses, opens, and shorts by Murray, Varley, Hilborn, or Fisher loop and capacitance tests; includes battery-operated power supply and a new type of galvanometer that withstands rough handling.—*Shallcross Mfg. Co., Collingdale, Pa.*

Mention No. 569 when filling out card.

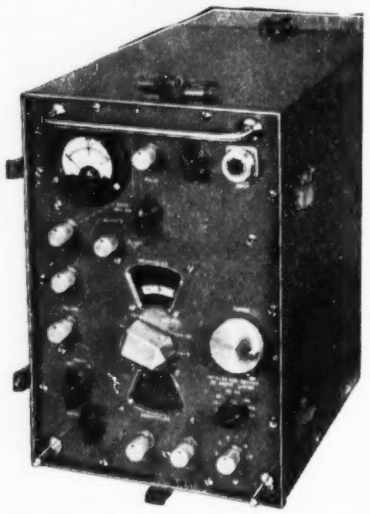
Bridge Indicator

New "Type 615-A Bridge Indicator" for balancing measuring bridges has approx. logarithmic response to allow balancing from coarse to fine without frequent range changes normally required with bridges. An output jack for earphones supplements visual indicater and enables precise aural null-detection without strain, even in noisy surroundings. Frequency response is flat from 60 cps. to 20 kc. Input voltage ranges, 0-1 volt and 0-100 volts. Maximum output, 1 volt. Built-in power supply. Instrument may be used as a tuned detector by connecting accessory filters to a filter output jack.—*Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.*

Mention No. 570 when filling out card.

Noise Meter

New "Model NF-114" noise meter (commercial equivalent of AN/PRM-14) has a total frequency range of 0.15 to 80 Mc., in 8 bands selected

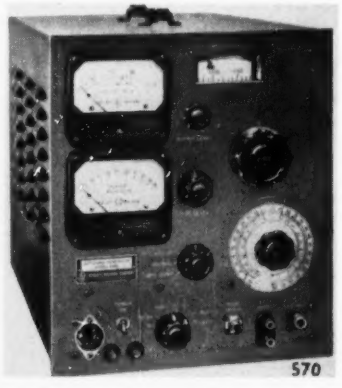


by means of a turret. A built-in impulse generator produces flat output to 100 Mc. VTVM indicates carrier or true peak voltage; an alternate means of measurement is aural slide-back operation. A complete line of accessories is available.—*Empire Devices Inc., 38-25 Bell Blvd., Bayside 61, N. Y.*

Mention No. 571 when filling out card.

Signal Generator

New "Model 612A" master oscillator power amplifier generator facilitates receiver and amplifier gain, selectivity, sensitivity, image rejection, and other UHF-TV measurements (450-1200 Mc.); serves also as a



ELECTRONIC TEST INSTRUMENTS

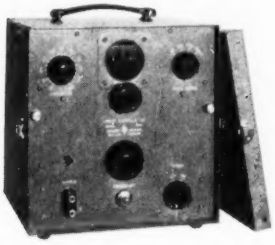
TEST VOLTAGE PROBLEMS 1/100 cps to 10 mc?

Hewlett-Packard has 17 different oscillator models. Some are highly specialized, others are all-purpose instruments. Almost certainly, there's a model to meet your exact requirements. All are precision instruments of highest quality. All embody the famous RC circuit pioneered by *-hp-*. Check the table below for the oscillator that can help you most. Then write us for complete operating and application details.

Instrument	Primary Uses	Frequency range	Output	Price
-hp- 200AB	Audio tests	20 cps to 40 kc	1 watt/24.5v	$120.00
-hp- 200CD	Audio and ultrasonic tests	5 cps to 600 kc	160 mw/20v open circuit	150.00
-hp- 200H	Carrier current, telephone tests	60 cps to 600 kc	10 mw/1v	350.00
-hp- 200I	Interpolation, frequency measurements	6 cps to 6 kc	100 mw/10v	225.00
-hp- 201B	High quality audio tests	20 cps to 20 kc	3w/42.5v	250.00
-hp- 202A	Low frequency measurements	.01 cps to 1 kc	20 mw/10v	450.00
-hp- 202B	Low frequency measurements	½ cps to 50 kc	100 mw/10v	350.00
-hp- 202D	Low frequency measurements	2 cps to 70 kc	100 mw/10v	275.00
-hp- 204A	Portable, battery operated	2 cps to 20 kc	2.5 mw/5v	175.00
-hp- 205A	High power audio tests	20 cps to 20 kc	5 watts	390.00
-hp- 205AG	High power tests, gain measurements	20 cps to 20 kc	5 watts	425.00
-hp- 205AH	High power supersonic tests	1 kc to 100 kc	5 watts	550.00
-hp- 206A	High quality, high accuracy audio tests	20 cps to 20 kc	+15 dbm	550.00
-hp- 230A	Carrier test oscillator	35 cps to 35 kc	+14 dbm/600 ohms	275.00
-hp- 233A	Carrier test oscillator	50 cps to 500 kc	3w/600 ohms	475.00
-hp- 234A	Carrier test oscillator	160 cps to 160 kc	+14 dbm/600 ohms	300.00
-hp- 650A	Wide range video tests	10 cps to 10 mc	15 mw/3v	475.00

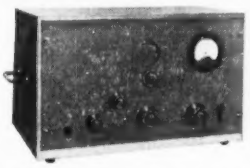
-hp- 200CD AUDIO OSCILLATOR

World standard for electronic or electrical measurements, now redesigned with wider range, lighter weight, smaller size. Use for any lab, field or production problem in subaudio, audio, telephony, carrier, supersonic, telemetering or rf measurement fields. Highest stability, low distortion, constant output, no zero set while operating. With carrying strap for bench or portable use; or for rack mounting.



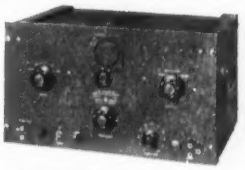
-hp- 204A Battery-Operated Oscillator

Precision instrument for measurements 2 cps to 20 kc where ac power is not available. Compact, light weight, weather-proofed—extra rugged construction for field duty. Frequencies set and read directly on large dial. Particularly useful for telephone or remote broadcast line checks, strain gauge applications, telemetering and geophysical measurements. Provides completely hum-free signal. Operates from flashlight and 45-volt batteries. Output stable and constant throughout range.



-hp- 650A Resistance-Tuned Oscillator

Highly stable, wide band (10 cps to 10 mc) oscillator particularly useful for testing television amplifiers, receiver alignment, bridge or carrier circuits, wide band systems; determining tuned circuit response. Operates independently of line or tube changes, requires no zero setting. Output flat within 1 db throughout range, monitored with VTVM. 60 db attenuator adjusts in 10 db steps.



-hp- 202A Low Frequency Function Generator

Compact, convenient, all-purpose source of transient-free voltages between 1/100 cps and 1 kc. Provides distortion-free signals for vibration studies, servo applications, medical and geophysical work and other subsonic problems. Generates sine, square or triangular waves. Output 10 v RMS, balanced or single ended, 1% distortion, constant within 0.2 db.

Data subject to change without notice. Prices f.o.b. factory

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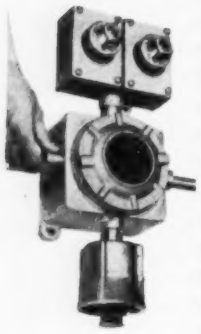
Instruments for Complete Coverage

DETECT combustible GAS

INDICATE • RECORD • CONTROL

J-W Model F Indicator checks the presence of combustible gas at inaccessible locations. Aspirator bulb draws air mixture through sampling hose and probe. Meter registers combustibility instantly. Fully portable, dry-cell operated.

MODEL F



MODEL EE

J-W Models E and EE Alarms monitor fixed installations where explosive hazards may exist. For continuous operation from standard 115-v a-c line. Actuate audible or visual signals, control valves or motors. Model EE is explosion proof. Model E is for installation remote from sensing unit.

J-W Sentinel Alarm serves as a fire-danger watch-dog under conditions of special localized combustible-gas hazard — such as: welding, electrical work, tank cleaning, etc. Storage-battery operated, inbuilt charger, penetrating audible alarm.

SENTINEL

Other models available for laboratory, oil-well logging, and other specialized uses. Your inquiry is invited on designs to meet particular requirements.

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NEW INSTRUMENTS

power source for driving bridges, slotted lines, antennas and filter networks. Maximum output 0.5 volts into 50 ohms throughout frequency range; broad band modulation up to 5 Mc.; low incidental FM.—*Hewlett-Packard Co., 335 Page Mill Rd., Palo Alto, Calif.*

Mention No. 572 when filling out card.

Cathode-ray Oscilloscope

New "Model 101" cathode-ray oscilloscope has 7-in. cathode-ray tube with P1 or P7 screen. Among features: provisions for direct connection

to all deflection plates; stability under varying line voltage conditions; sweep 2 cps. to 30 kc. with provision for lower frequency with external capacitor 0.5 sec. sweep per microfarad; single sweep triggered time base; sweep may be triggered (or synchronized) by positive or negative pulse signals of 40 mv.; voltage calibration circuit provides measurement of input signals by means of substitution voltages in the form of 60-cycle square wave direct reading 0.01 volt to 100 volts in 4 steps; vertical amplifier is flat from direct current to 200 kc.—*Telctronic Laboratories, Inc., 1835 W. Rosecrans Ave., Gardena, Calif.*

Mention No. 573 when filling out card.

Cathode-ray Oscilloscope

New "ELCO Model 470" 7-inch oscilloscope is available in kit or wired form, is said to "combine the practical

suggestions submitted by hundreds of Servicemen we interviewed all over the country, plus a host of new advanced laboratory-precision features, plus the lowest price ever tacked onto an instrument of such high quality."—*Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y.*

Mention No. 574 when filling out card.

Pocket Volt-ammeters

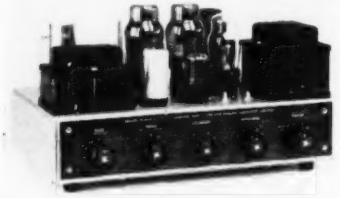
New series of three "Amprobes," maker's pocket-size a-c. volt-ammeters with "snap-around" jaws, comprises:

"Model 300" with nine ranges up to 300 amps. 600 volts; "Model 600" to 600 amps. and 600 volts; "Model 1200" to 1200 amps. and 600 volts.—*Pyramid Instrument Co., Inc., Lynbrook, N. Y.*

Mention No. 575 when filling out card.

Audio Amplifier

New "Type 210-B Dynaural Laboratory Amplifier" features "Dynaural Noise Suppressor" with increased effectiveness of rumble suppression, re-



flecting trend to new loudspeaker systems with extended bass response. An adjustable record-distortion filter is provided to limit high-frequency response to what actually is recorded.—*Hermon Hosmer Scott, 385 Putnam Ave., Cambridge 39, Mass.*

Mention No. 576 when filling out card.

Wide-Band Amplifier

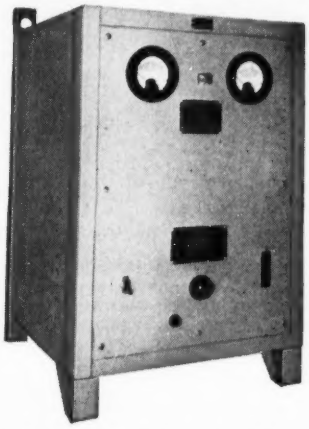
New "Model 202C Wide Band Chain Amplifier" has extended bandwidth of 1 kc. to 210 Mc. Twelve 6AK5 tubes in a chain circuit provide gain of 20 db, uniform within 1.5 db over bandwidth. Rise time (10-90 percent ampl.) less than 0.0026 usec. Input

and output impedance 200 ohms with stabilized power supply which prevents gain fluctuations due to line voltage changes. Unusually low noise figure (9 db). Unit is useful as a booster for signal and pulse generators oscillators, or scintillation counters. It increases sensitivity of VTVMs, crystal and mercury delay lines; besides obvious use with photomultiplier tubes, as IF amplifier in high-resolution radar, amplification of high-speed and transient voltage, etc.—*Dep't I, Spencer-Kennedy Laboratories, Inc.*, 186 *Massachusetts Ave., Cambridge* 39, *Mass.*

Mention No. 577 when filling out card.

Regulated Power Supply

New regulated d-c. thyratron power supply has d-c. output of 110 volts plus-or-minus 5 volts at 5 amperes. A manual adjustment is provided so



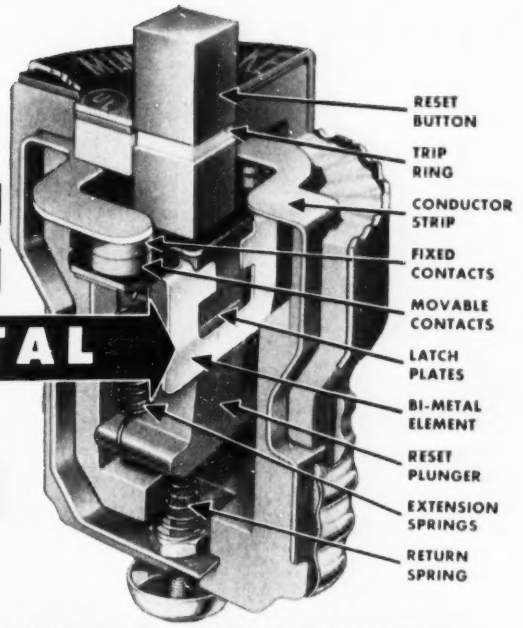
that d-c. output voltage to 110 volts may be returned at any condition of a-c. line voltage or d-c. output. Power supply includes d-c. instrumentation, is air-cooled and designed for operation in ambient temperatures up to 40 deg. C.—*Richardson-Allen Corp.*, 116-15 *Fifteenth Ave., College Point, L. I., N. Y.*

Mention No. 578 when filling out card.

Laboratory Amplifier

New "Type 140-A Decade Amplifier" is a miniaturized laboratory voltage amplifier with 1-Mc. frequency response and stabilized voltage gains of 10 and 100. It is entirely resistance coupled; no peaking coils or compen-

CHACE BIMETAL puts perpetual life in MECHANICAL PRODUCTS' MINI-BREAKER®



Product of Mechanical Products, Inc. Jackson, Mich.

The Mini-Breaker, manufactured by Mechanical Products, Inc., is a plug type circuit protector that provides positive, permanent protection against overloads and short circuits in electrical appliances and the wiring of residential or commercial buildings. Mini-Breakers are installed in Edison base fuse sockets and are built in 15, 20, and 30 ampere ratings. The trouble-free actuating element is largely dependent upon Chace Thermostatic Bimetal.

Under normal line conditions, electric current passes through the Conductor Strip and the Chace Thermostatic Bimetal actuating element, which carries a pair of movable contacts. On a direct "short" or a sustained overload, the excessive heat generated causes the element to bend away from the latch plates on both sides of the center reset plunger. A preloaded return spring then forces the plunger outward while twin extension springs pull the element and the movable contacts back . . . away from the fixed contacts . . . thus breaking the circuit. The circuit is restored by pressing in the reset button.

Chace Thermostatic Bimetal is manufactured in 29 types, in strips, coils, random long lengths and welded or brazed sub-assemblies. We also provide specialized tooling necessary to fabricate bimetal elements to customer designs. Before proceeding with your next design, we invite you to consult our Application Engineers, recognized authorities on temperature responsive devices—or write today for your copy of our 32-page booklet "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

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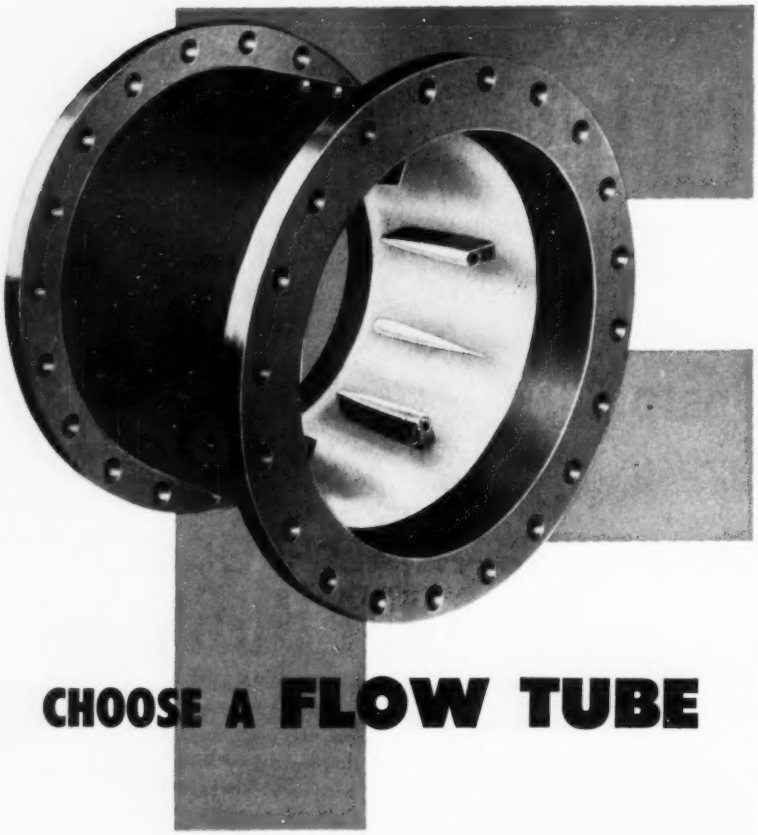

CHOOSE A FLOW TUBE

The Flow Tube is available in types and D/d ratios to handle a wide range of fluids and main line velocities. This flexibility enables you to use the one Flow Tube that will produce differentials that can be accurately measured, with the least head loss.

Flow Tubes have many other plus values—they're compact, comparatively light weight, and are easy to install since they require minimum straight runs entering and following. All Flow Tubes are furnished with head-capacity curves obtained in laboratory tests and can therefore be guaranteed as to accuracy.

That's why Flow Tubes are being successfully used in scores of installations metering the flow of liquids and wet or dry gases. Available in all pipe sizes and suitable metals. They can be furnished with or without suitable secondary indicating, recording or totalizing instruments. For further information, write for Bulletin FT102. For specific recommendations, send us necessary flow data.

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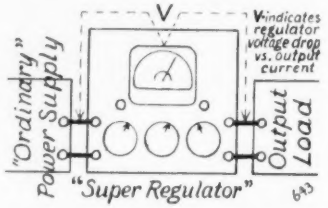
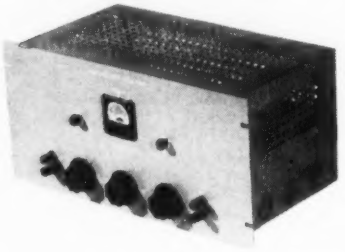
sating networks which might cause undesirable transient effects. Maximum undistorted output voltage, 40 volts; maximum output current, 1 milliamp.; phase shift and distortion negligible. Line voltage variations between 70 and 130 volts cause less than 0.1 db changes in output. Input impedance, 1 megohm shunted by 10 mmf. An accessory high-impedance vacuum-tube probe is available.—*Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.*

Mention No. 579 when filling out card.

Regulator for Power Supplies

New "Kay-Lab Super-Regulator," for use with either regulated or unregulated power supplies "to provide the ultimate in low internal impedance, low noise, maximum flexibility and reliability," includes a separate power supply for screen voltage of series pentodes which isolate ripple



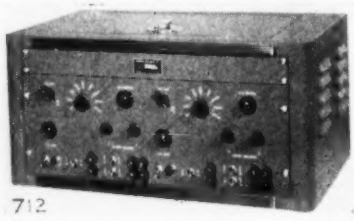


and impedance variations of unregulated supply from regulated output. Voltage range, 200-350; current, 0-600 ma.; d-c. regulation factor for 500-ma. change, 0.003 percent. Other ranges available.—*Kalbfell Labs., P.O. Box 1578, San Diego 10, Calif.*

Mention No. 580 when filling out card.

Dual-channel Amplifier

New dual channel strain amplifier, features two amplifiers on one standard 19-in. panel, is of carrier type, of specific value in its ability to analyze either static or dynamic strain. When used with maker's magnetic oscillograph and suitable pickups, oscillo-



grams of pressures, velocities and strains are readily obtained. Available also in two, four and six channels.—*Photron Instrument Co., 6516 Detroit Ave., Cleveland, Ohio.*

Mention No. 581 when filling out card.

FOR INSTRUMENT SHOP

Surface Roughness Specimens

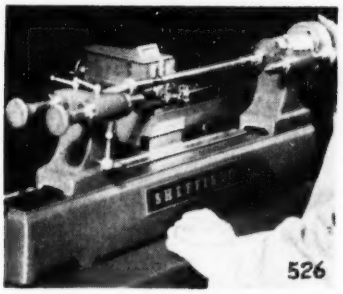
New "Surface Sticks," roughness comparison specimens, consist of assorted surface specimens individually finished to definite microinch read-

ings and grouped together in handy finish-comparison bars. They are furnished in approx. 1 x 1 in. round plug form, and in approx. 1 x 1½ x 1 in. rectangular blocks, in boxes accommodating 3, 5 or 8 assorted surface finishes.—*Acme Industrial Co., 200 N. Laflin St., Chicago 7, Ill.*

Mention No. 582 when filling out card.

Lead-measuring Instrument

New "Universal Lead Measuring Instrument" accurately determines lead of internal and external threads of workparts up to 8 in. in diameter



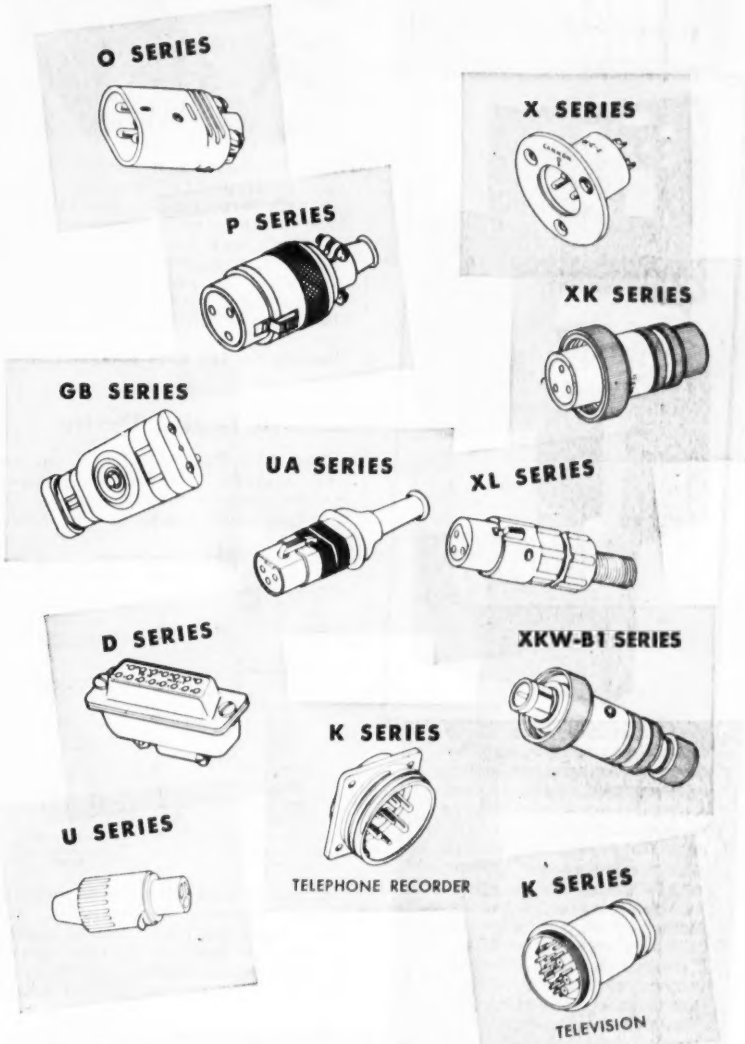
and 18 in. in length. Fixed headstock carries what is virtually the barrel of a micrometer; longitudinal carriage supports totally-enclosed micrometer nut; a weight insures that thrust is always in same direction. On this, another carriage which supports amplifying and indicating unit (magnification 400) is mounted and can be traversed longitudinally and locked.—*The Sheffield Corp., Dayton 1, Ohio.*

Mention No. 583 when filling out card.

Hypodermic Lubricating Kit

New complete kit of lubricating and cementing tools consists of four items: "Hypo-Oiler" pen-size oiler with hypodermic needle and cap with pocket

CANNON PLUGS *get good reception*



The high quality audio connectors shown above are available from all Cannon Franchised Distributors. In their great variety of sizes, shapes and contact arrangements there is no problem or technical requirement in the radio, sound, TV or related fields that cannot be met. Cannon plugs are standard on leading makes of audio equipmen: and microphones.

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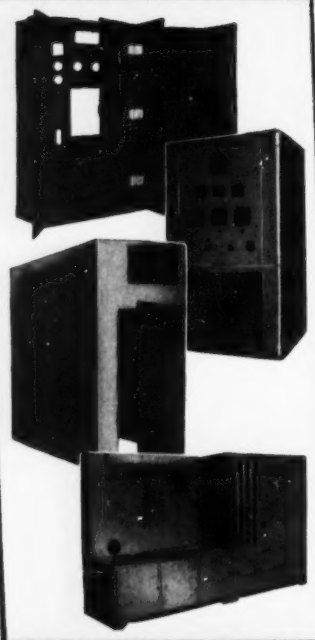

Manufacturers of Electrical and Hydraulic Control equipment must have accuracy in the fabrication of Cubicles, Cabinets, Control Boards and Panel Boards. Accuracy comes through experience in knowing how to shear, bend, form and weld plate and sheet metals. Littleford has that experience, plus skilled craftsmen, as industry has been served by Littleford since 1882.

These long years of producing fabricated products reflect in the finished unit. Littleford facilities are modern and afford an unprecedented standard of dependability and quality. If you have a problem involving accurate fabrication remember there is no substitute for experience, and no substitute for Littleford workmanship.

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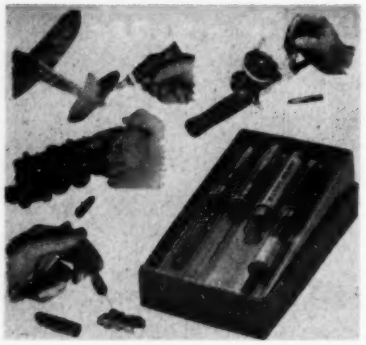
NEW INSTRUMENTS

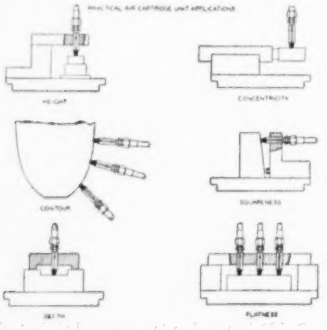


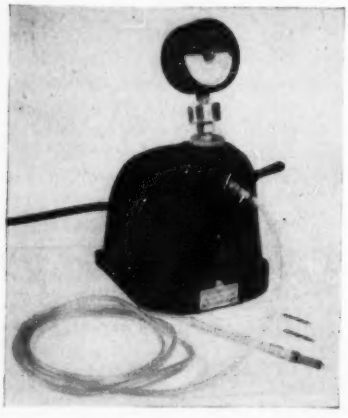
clip; "Hypo-Jr," 2/3 size of "Hypo-Oiler"; "Hypo-Lub" pen-size grease gun with large needle; and "Handy-Hypo" adaptor with hypodermic needle which may be screwed on tubes of cement, glue, grease, or oil, with a steel wire for preventing materials from drying in bore.—*Dep't IN, Gaunt Industries, 827 Irving Park Rd, Chicago 13, Ill.*

Mention No. 584 when filling out card.

Air Gaging Device

New "Air Cartridge Unit," for use with maker's "Air-O-Limit" gages, can be used in multiple-station fixture-type gages (same as dial indicators can be used) to check squareness, height, contour, concentricity, flatness, depth, etc.; also can be applied to machine tools to indicate runout. As direct size indicator, it gives operator an indication as finished dimension is approached. Once magnification is established with feeler gages, unit may be applied to any fixture and zeroed with simple setting master or even a measured product. Standard units are available in three magnification ranges with total scales of 0.010, 0.015, and 0.020 in.; total scales from 0.006 to 0.003 in. are available.—*Pratt & Whitney Div., Niles-Bement-Pond Co., W. Hartford, Conn.*

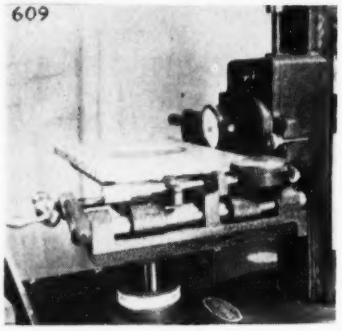




Mention No. 585 when filling out card.

Optical-comparator Stage

New universal type coordinate stage for use on maker's "Model C-100" optical comparator has two dial indicators and two micrometer spindles for both longitudinal and transverse travel measurements. Stage unit is adjustable for helix angle positioning up to ten degrees either side of center. "Swing-Away" feature permits change-over of lens units without disturbing work on stage. Platform (6x 9-1/4 in.) has 4-in. diameter removable glass stage insert disk.—*Portman Instrument Co., Inc., 6 Manhasset Ave., Port Washington, N. Y.*



Mention No. 586 when filling out card.

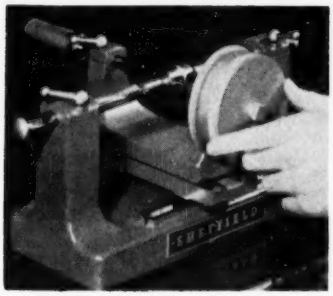
Dial Micrometer

New "Hand Model Micrometer" has 2¾-in. glass-covered dial graduated in thousandths. Capacity is 0.5 in. Standard anvil is 9/16 in. diameter. Anvils can be supplied in larger or smaller diameters and flat or spherical ends. Lever is conveniently located for easily raising anvil for insertion of material. Anvil pressure is approx. 7 to 9 psi. (TAPPI standard).—*E. J. Cady & Co., 134 N. LaSalle St., Chicago 2, Ill.*

Mention No. 587 when filling out card.

Diameter-measuring Machines

New floating-carriage diameter measuring machines are available in three models with 4-, 7-, and 12-in. capacities (8, 12-1/2 and 14 in. between centers). At right angles to axis of centers is a freely-moving measuring carriage mounted on balls in vee ways and carrying a micrometer (with non-rotating anvils) and

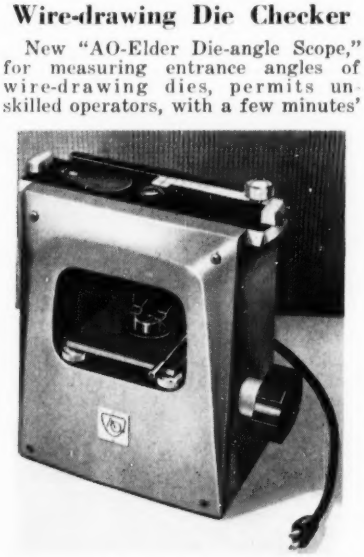


reference-point indicator. Repetitive checking of similar components can be carried out rapidly. Micrometer unit has a large anti-glare drum, with vernier scale for direct readings to 0.00001 in. Reference-point mechanical indicators enable thread elements to be measured to within 0.00001 in. irrespective of "feel" of micrometer; magnify movement of micrometer anvil 350 times.—*The Sheffield Corp., Dayton* 1, *Ohio.*

Mention No. 588 when filling out card.

Wire-drawing Die Checker

New "AO-Elder Die-angle Scope," for measuring entrance angles of wire-drawing dies, permits unskilled operators, with a few minutes'



instruction, to read entrance angles to 10 minutes of arc. Die is not damaged. Multiple angles and poor polish are obvious immediately. Instrument has integral light source and transformer.—*Instrument Div., American Optical Co., Buffalo* 15, *N. Y.*

Mention No. 589 when filling out card.

Dial Bore Gages

New "PT" and "PU" groove gages for small diameters include standard models small enough to enter a 0.310 in. bore and measure groove diameters

AEMCO

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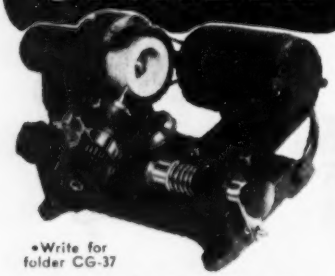

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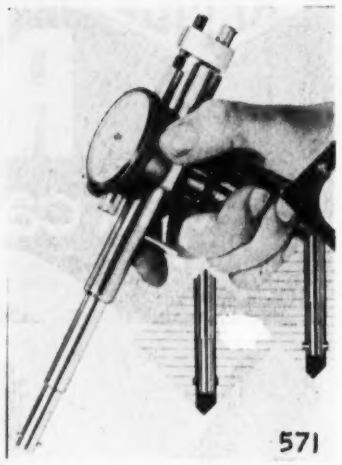
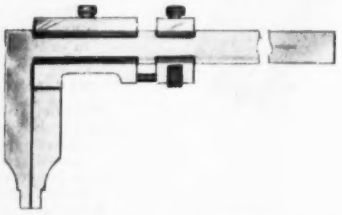


for "O" ring AN6227-6 and snap ring groove NAS-50-31. Measurement of thread reliefs, by-pass reliefs in hydraulic mechanisms, are among other uses.—*Rimat Tool Co., 21 West Dayton St., Pasadena 2, Calif.*

Mention No. 590 when filling out card.

Large Vernier Calipers and Height Gages

New vernier slide calipers (made in U. S. Zone of Germany), in sizes from 10 to 96 in., are of hardened chrome steel, with graduations read-

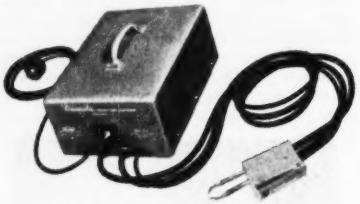


able to 0.001 in. Jaws are hardened, ground and lapped. Wooden case is provided. Also available are vernier height gages in sizes from 12 to 48 in.—*Dep't F, Glogau & Co., Inc., 1914 Birchwood Ave., Chicago 26, Ill.*

Mention No. 591 when filling out card.

Instrument Welder

New "Model 1012 Unimatic Tweezer-Type Spotwelder," for producing instrument welds with production-line efficiency, incorporates a circuit said to insure welds that are consistently uniform, burn-free, spatter-free and dependably secure. Tweezer-type electrode-switch assembly provides automatic control of welding pressure. Equally satisfactory results

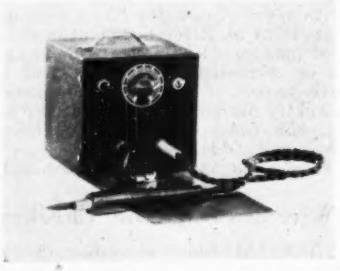


are said to be obtained whether welding two 0.0008 in. diam. copper or Nichrome wires or two 0.018 in. sheets of Type 302 stainless steel.—*Unitek Corp., 275 N. Halstead Ave., Pasadena, Calif.*

Mention No. 592 when filling out card.

Soldering Units

New "Model L-72 Glo-Point" (illustrated), added to maker's line of soldering units, features a metal ground plate for mounting jigs, and



adjustable heat control. New "Model L-80" is also announced for heavier soldering work.—*Sunrise Products Co., P. O. Box 173, Hawthorne, N. J.*

Mention No. 593 when filling out card.

Rosin-core Solder

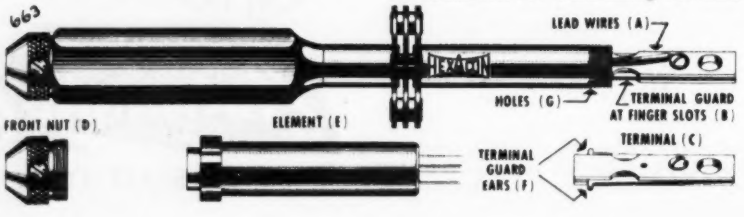
New "RTS 200" rosin-core solder is active, yet non-corrosive; has a spread 30 percent greater than that of conventional rosin core solders. Oxide films and corrosion products on parts being soldered need not slow down operations, because new solder "pierces such retarding agents four times faster than ordinary solders." No harmful corrosion residue when tested under high humidity conditions of MIL-S-6872. Chemicals used have no toxicity factor.—*Federated Metals Division, American Smelting and Refining Company, New York, N. Y.*

Mention No. 594 when filling out card.

Quick-change Soldering-iron Element

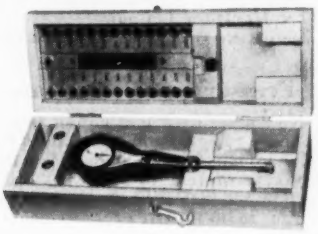
New quick-change feature obviates need of "fishing" wires; includes brass sheath which prevents damage to resistance wire and mica when replacing element.—*Hexacon Electric Co., 175 W. Clay Ave., Roselle Park, N. J.*

Mention No. 595 when filling out card.



Centering Size Disks

New complete set of 27 centering-size disks enables maker's No. 00 dial bore gage to measure any bore within its over-all range of 0.25 in. to 0.375

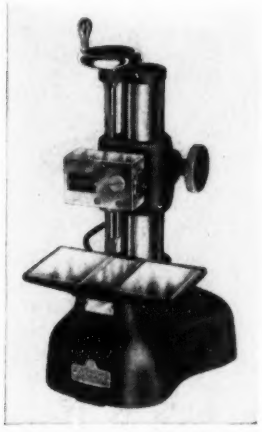


in. Previously this gage had been presented as a "single-hole" gage to be furnished with a centering-size disk proper for checking of one dimension specified by user.—*Standard Gage Co., Inc., Poughkeepsie, N. Y.*

Mention No. 596 when filling out card.

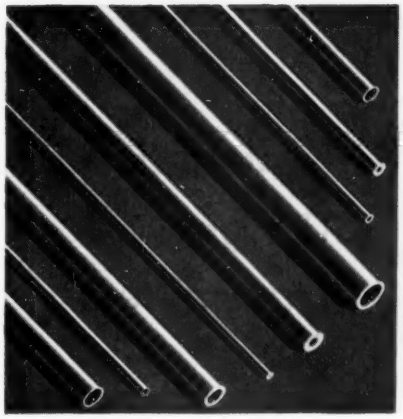
Indicator-recorder for Microinch Comparator

New "Millionth Comparator," combination of "Universal Electrolimit Circuit," "Gage Block Comparator Stand" and "P&W Electronic Re-



corder," was developed primarily for checking precision gage blocks to one millionth of an inch, but will find other uses in industry. Recorder's 11-inch scale is equal to 0.0001 in. with

each primary division equal to five microinches and secondary divisions to one microinch. Recorder is provided with a pen lifter and chart drive



Yes, it's tubing—Uniform "Pointer" tubing used as the indicator in this Simpson Electric Company Model #1029 Milliammeter. Uniform pioneered the development of delicate, aluminum alloy "Pointer" tubing; today furnishes over 50% of all such tubing used in the United States.

Photo courtesy of Simpson Electric Company, Chicago, Illinois.

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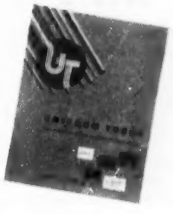

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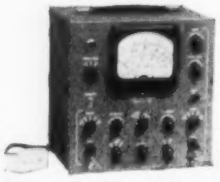

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(2) Phase angle between two voltages.
(3) Imaginary and real components of an unknown voltage in terms of a reference voltage.
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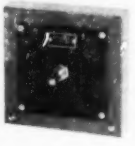

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NEW INSTRUMENTS

switch so that under normal operation it is used as an indicating instrument. However, by using switch, a permanent record is obtained.—*Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford 1, Conn.*

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Pressure-sensitive Tape

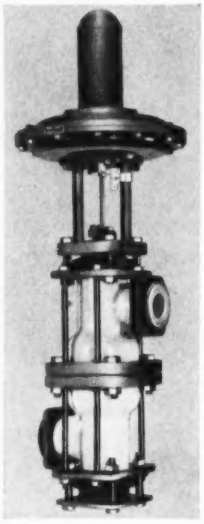
New pressure-sensitive felt tape has no liner, can be applied instantly from rolls to job, can be made in rolls of any type of felt, in any thickness up to quarter-inch and in widths from 3/8 in. to 36 in. Or, pressure-sensitive felt can be supplied in any thickness in flat pieces square-cut or die-cut to any size.—*Dep't 28, Froll Mfg. Co., 9900 S. Ridgeland Ave., Chicago Ridge, Ill.*

Mention No. 598 when filling out card.

VALVES

Porcelain D-m. Valve

New improved model of porcelain "Valvrator" diaphragm-motor valve for control of corrosive liquids and gases has new safety "armored" feature affording maximum protection



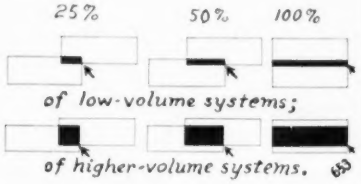
against thermal or physical shock. Porcelain fittings are encased in layers of glass cloth impregnated with resin mixture to form a corrosion-resistant cladding with physical properties approaching those of steel Four sizes fit ¼-in. pipe to 2-in. pipe; linear or characterized flow-lift characteristics.—*Fischer & Porter Co., 771 Jacksonville Rd., Hatboro, Penna.*

Mention No. 599 when filling out card.

Oil Flow Control Valve

New multi-range flow control valve, for controlling oil flow in a hydraulic system, is designed for operating pressures up to 3000 psi. and offered in 2-port and 3-port types in ¼-in., ⅜-in. and ¾-in. sizes for subplate mounting; also with or without built-

in checks. Oil flow can be maintained at a uniform rate regardless of circuit pressure variation. Should flow requirements of a circuit change, orifice

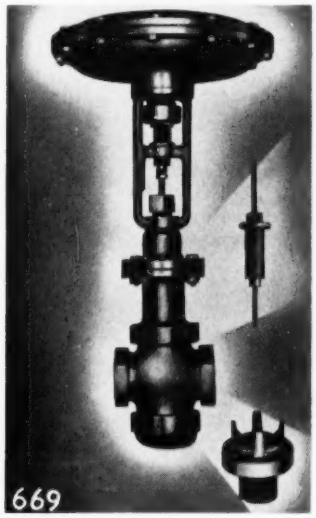


may be adjusted to control a lesser or greater delivery and still provide a 100-percent scale adjustment of selected volume.—*The Denison Engineering Co., 1160 Dublin Road, Columbus 16, Ohio.*

Mention No. 600 when filling out card.

Bellows-sealed D-m. Valve

New "Type 27" bellows-sealed diaphragm-motor valve, originally designed for use in testing jet aircraft engine fuels, handles media such as

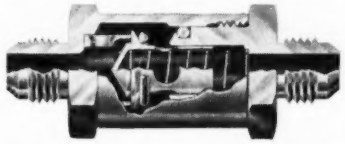


gasoline, water mixtures, alcohols, ethers, ketones, kerosene, jet fuels, etc.; features bronze bellows stem seal and composition disk. Standard sizes from 1 to 3 in.; tight shut-off with any pressure drop from 0 to 60 psi. in all body sizes; maximum inlet pressure 60 psi.—*Valve Div., Minneapolis-Honeywell Regulator Co., Philadelphia 44, Pa.*

Mention No. 601 when filling out card.

Low-Pressure Relief Valve

New "5400 Series" adjustable low-pressure relief type valve employing maker's "Circle-Seal" principle is designed for controlling gases safe to



release into atmosphere, is available for relief pressures from 2 to 45 psi. Adjustments can be set at factory or by users. New valves are supplied in aluminum or brass, made to order of

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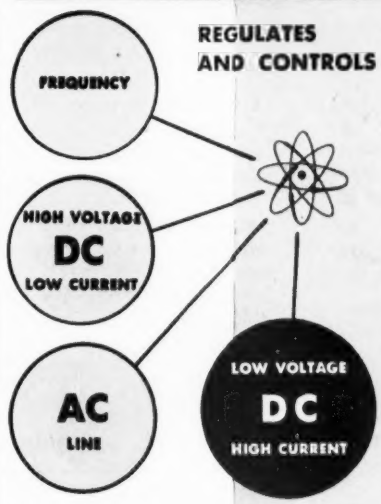

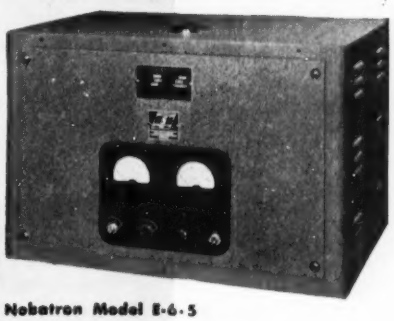

Nobatron Model E-6-5

The NOBATRON* maintains stabilized DC voltage under changing line and/or load conditions.

A complete line of catalog models are available, with output voltages of 6, 12, 28, 125, and 200 VDC, from 5 to 350 amperes.

Sorensen Nobatrons eliminate battery and generator troubles. They combine high regulation accuracy with maximum dependability and minimum maintenance.

All models are attractively finished. Most can be furnished either for relay rack mounting or in cabinets for bench-top use. Most units are metered; all are adequately protected against overload by suitable fuses and breakers.

WIDER OUTPUT VOLTAGE RANGE MODELS

Nobatron-RANGERS* are designed to meet the demand for power supplies similar to the Nobatron but with wider output voltage ranges.

Nobatron-RANGERS are continuously adjustable over extended output ranges, yet provide regulation accuracies of ±0.25% against line and/or load. Other specifications are identical to those of the standard Nobatrons.

Three models are available, the SR-30, SR100, SR-2. Capacities, respectively, are 3 - 30 VDC at 3 - 30 amperes, 3 - 135 VDC at 1 - 10 amperes, and 100 - 300 VDC at 1 - 10 amperes.

Investigate NOW the cost of a NOBATRON installation versus the overall cost of less satisfactory DC sources.

COMMON NOBATRON SPECIFICATIONS

Input voltage range	95-130 VAC, single ϕ, 50-60 ~ High-current units 208/115, 3ϕ, 4-wire, wye.
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Regulation accuracy	± 0.2% from 1/10 to full load.
Ripple voltage	1% RMS. Time constant 0.2 seconds.

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In this group are men who are expert in each specific industry. One group, for example, specializes in instrumentation for the metalworking industry . . . another for chemical . . . another for petroleum . . . until the whole gamut of modern manufacturing is represented. Each man has been trained, by education and first-hand experience, in the techniques of processing and process control in the area of his interest. Each is a living part of the industry he serves. And he knows why and where every process "is different."

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Honeywell application engineering covers the entire control installation. It works out details of what instrument to use for each measurement or control function . . . what type of primary element . . . what control system . . . what size and style of valve. It provides all essential signals, safety interlocks, and accessories. It combines all these elements into a complete unit, arranged for peak production efficiency . . . greatest convenience of the operator, and for maximum ease of service . . . custom-fitted to the individual needs of the process to be controlled.

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This Honeywell service gives specialized consultation on complex control problems that would otherwise require the attention of experts in the individual plant. But most important, it assures a control system that will produce the superior performance that Honeywell instruments are capable of giving . . . and which will help to obtain the most production and best quality from the process which it serves.

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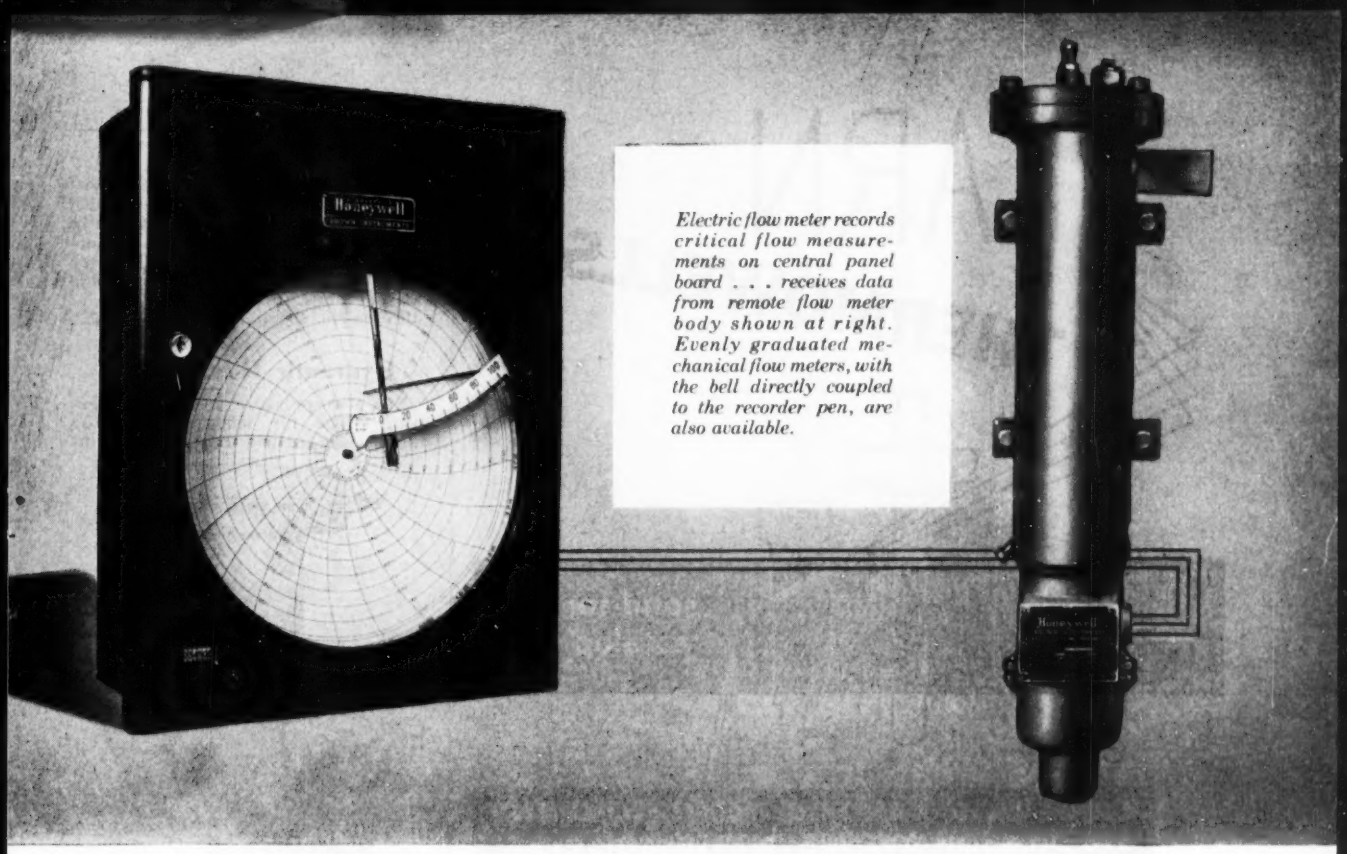

Electric flow meter records critical flow measurements on central panel board . . . receives data from remote flow meter body shown at right. Evenly graduated mechanical flow meters, with the bell directly coupled to the recorder pen, are also available.

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ACCURATE information on steam and water flow at vital points in the plant is always at your fingertips when you use the Brown Electric flow meter. Electric transmission brings data accurately, instantaneously from the point of measurement. This instrument's evenly graduated scale and chart provide easy readability and consistent accuracy at all flow values . . . invaluable in cost accounting and heat balance calculations.

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The meter body features corrosion-resistant, light weight design . . . has a characterized bell . . . designed to provide the utmost accuracy.

Our local engineering representative will be glad to discuss applications to your plant's flow-measuring problems. Call him today . . . he is as near as your phone.

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● **REFERENCE DATA: Write for Catalog 2300, "Evenly Graduated Flow Meters"... and Bulletin 90-2, "Supervisory Instruments for Power Generation."**

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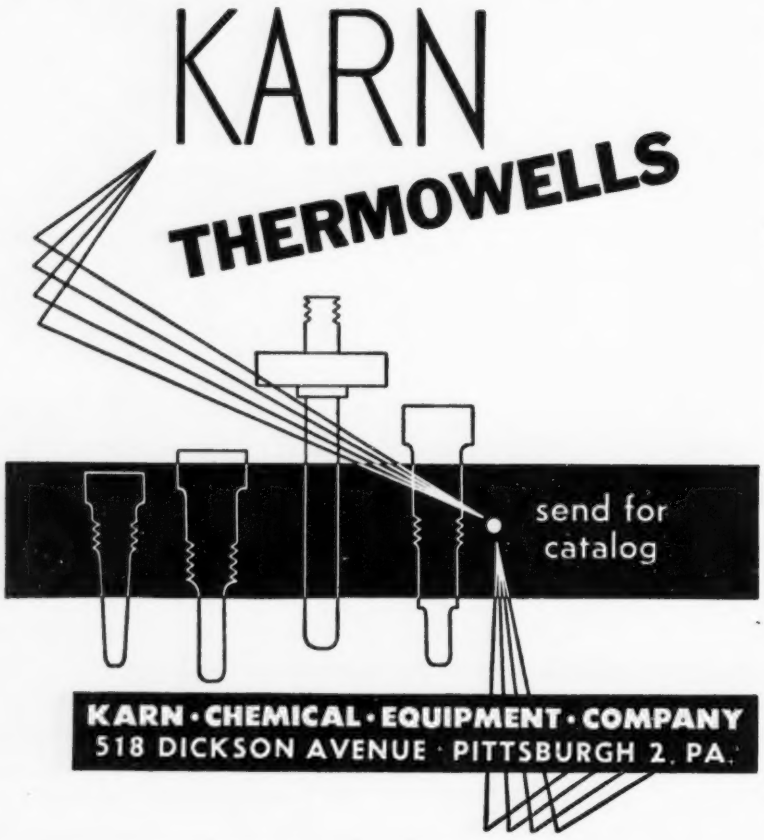

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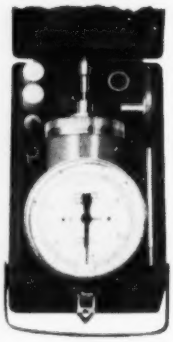

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Model B	45—18,000 RPM
Model C	60—24,000 RPM
Model D	120—48,000 RPM

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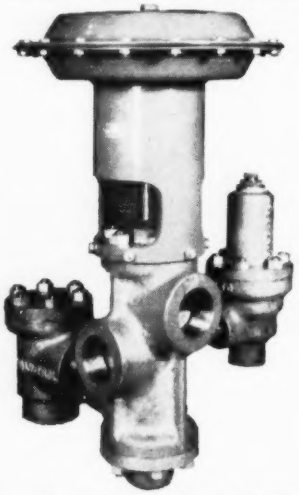
other desired materials; ⅛-in. or ¼-in. male pipe connections, larger sizes if specified. Operating temperatures 40 to 280 F. in production units, with "O" rings for temperatures as low as —80 F. or as high as 400 F.—*James-Pond-Clark, 2181 E. Foothill Blvd., Pasadena 8, Calif.*

Mention No. 602 when filling out card.

Hydraulic D-m. Valves

New two-pressure hydraulic operating valves for 3500 psi. water or oil service feature renewable stain-



less steel seats, Stellite-faced Monel disks, and fabricated steel diaphragm motors. Other two-, three- and four-way valves available to 10,000 psi.—*Valv-Trol Co., 571 Baird St., Akron 11, Ohio.*

Mention No. 603 when filling out card.

Flow-control Air Valves

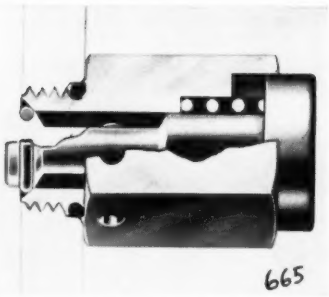
New "Model FC" valves, for controlling speed of piston stroke in pneumatic cylinders by controlling flow of exhaust air (rather than supply air)

are available in six sizes from ¼-in. to 1¼-in., for air, oil and water pressures to 500 psi.—*Airmatic Valve, Inc., 7317 Associate Ave., Cleveland 9, Ohio.*

Mention No. 604 when filling out card.

Manual Release Valve

New "Series 228" manually-operated release valve allows rapid escape of air from pressure systems, bleeding of air out of fluid systems, etc. Valve is normally held closed by a spring



665

when manual pressure is released. Over-all external length is less than 1 in.—*James-Pond-Clark, 2181 E. Foothill Blvd., Pasadena 8, Calif.*

Mention No. 605 when filling out card.

MECHANICAL COMPONENTS

Pipe-line Filters

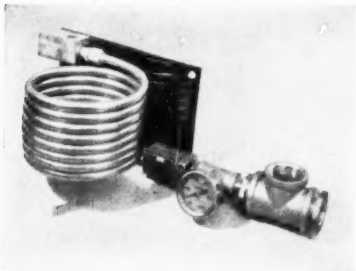
New small pipe line filters, for installations requiring 40 psi. maximum air or gas pressure, feature one-bolt accessibility for quick inspection and

cleaning without removing filters from line. Units are available in four models in two sizes, each size can use either absorption pad or maker's original radial fin inserts.—*Dollinger Corp., 11 Centre Park, Rochester 3, N. Y.*

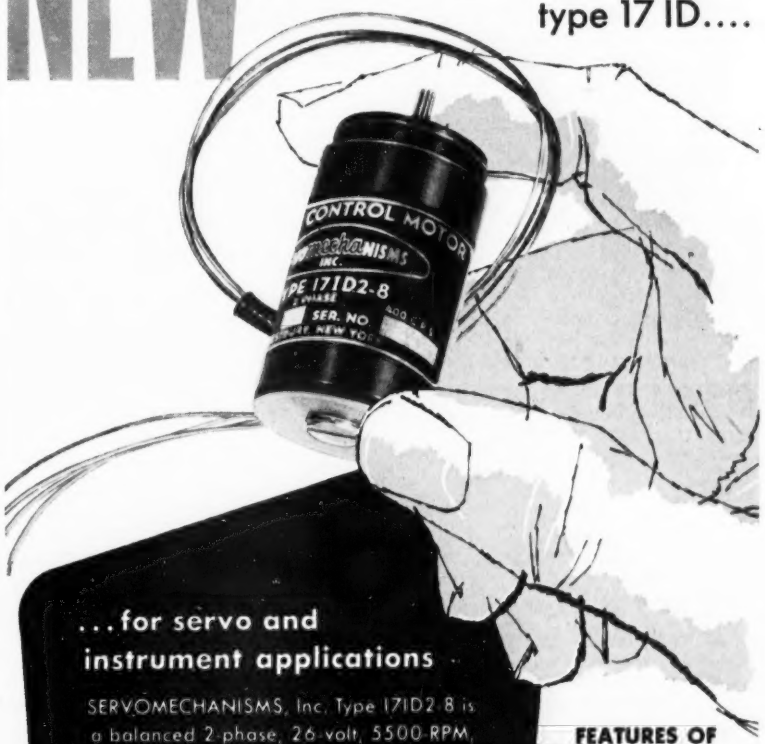
Mention No. 606 when filling out card.

Sample Cooling Coil

New "Model SC-7A-B-W Sample Cooling Coil" comprises a cupro-nickel concentric coiled tubing, stainless steel connecting blocks, dial thermometer



NEW miniature damped control motor type 17 ID....



...for servo and instrument applications

SERVOMECHANISMS, Inc. Type 17ID2-8 is a balanced 2-phase, 26-volt, 5500-RPM, 400-cycle damped induction motor employing a drag cup and an axially adjustable magnet to achieve velocity damping. This design provides for variable and smooth linear velocity damping and lower operating temperature. The desired degree of viscous damping is achieved by operating setscrew adjustment.

* * *

The non-damped induction control motor 17I2-8 of 8,000 RPM is also available.

FEATURES OF DAMPED CONSTRUCTION DESIGN INCLUDE

- Cogless Damping
- Zero Residual Noise Signal
- Constant Damping
- Lower Inertia
- Lower Cost

Write to Dept.-CLO-3 for specific information on motors.

OTHER INSTRUMENT MOTORS

.....Hysteresis Synchronous design, Type 17HI-8 for 26 volts and Type 19H for 115 volts in speeds of 8,000, 12,000, and 24,000 RPM are available for various applications. Special windings and external shaft configuration can be provided on request.

SERVOmechaNISMS INC.
WESTBURY, L. I., N. Y.
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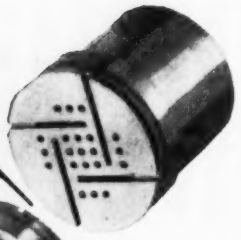
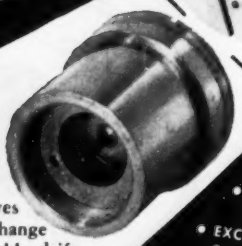
Midget Condenser Microphone for PRECISION SOUND MEASUREMENTS AND HIGH QUALITY RECORDING





Built to endure! Gives years of service without change in calibration. Shows no detectable drift in laboratory service, even without dessicators! Proved by use for optimum performance for more than 16 years.

- RUGGED CONSTRUCTION
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PRINCIPAL CHARACTERISTICS	MODEL A	MODEL B
RESPONSE Referred to 1 volt /dyne/cm²	—59 db	—55 db
FLAT TO WITHIN	±3 db from 20 to 11,000 cps, for closed cavity without grille.	±4 db from 20 to 15,000 cps with or without grille for perpendicular incidence in free field.

Users include government laboratories, universities, audio development laboratories, sound studios and industrial plants manufacturing sound equipment.

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in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)

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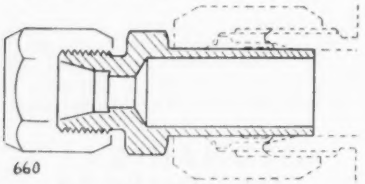
and bracket for wall mounting; allows for checking of high-pressure steam or boiler water by means of an electrolytic conductivity cell.—*Industrial Instruments, Inc., 89 Commerce Road, Cedar Grove, N. J.*

Mention No. 607 when filling out card.

Tube-end Reducer

New tube end reducer converts any "Ferulok" fitting (within 1/4-in. to

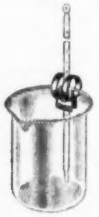


1-in. OD tubing size range) into a combination size unit, permitting connection of a smaller tube.—*Parker Appliance Co., 1732 S. Euclid Ave., Cleveland 12, Ohio.*

Mention No. 608 when filling out card.

Thermometer Clamp

New "Thermo-clamp" holds thermometer upright against side of beaker even when solution "bumps." Made of stainless steel, it is 1 in. in diam-

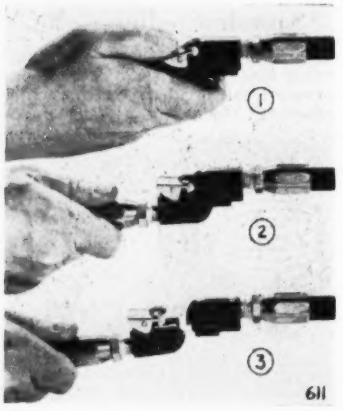


eter, ¾ in. wide; attaches thermometer to lip of any beaker; comes in boxes of one dozen.—*Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.*

Mention No. 609 when filling out card.

Self-sealing Fluid-line Coupling

New "Slide Seal Coupling" permits instant connection and disconnection of fluid-carrying lines by means of a simple push-pull action: motion similar to that used when inserting and removing a plug from an electrical outlet. Consisting of two simple 2-



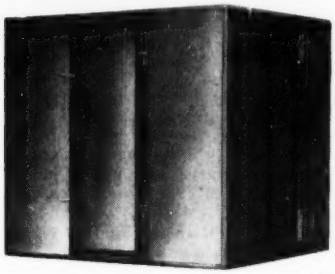
611

piece die-cast aluminum assemblies with rubber "O" rings, new coupling is light in weight and low in cost. It may be used with hydraulic fluids, water, oils, gasoline, diesel fuels, air, etc.—*Aeroquip Corp.*, 300 *South East St., Jackson, Mich.*

Mention No. 610 when filling out card.

Shielded Enclosure

New type of prefabricated shielding enclosure for suppression of radio interference features solid sheet-copper panels which permit exposure to ad-



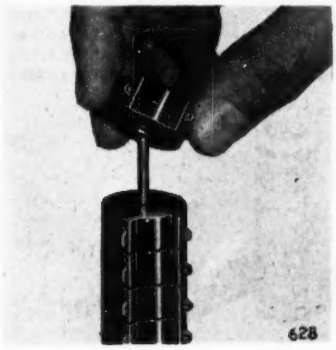
verse weather and provide durability. Attenuation characteristics equal those of conventional copper-screening rooms. Construction enables inexperienced personnel to assemble or disassemble a room indoors or out with standard tools. Available 8 feet high in eight floor sizes from 6 x 8 feet to 15 x 10 feet; optional air-conditioning and provisions for mechanical or electrical power, water, gas, and air.—*RFI Shielded Enclosures, Inc.*, 3634 *N. Lawrence St., Philadelphia* 40, *Pa.*

Mention No. 611 when filling out card.

ELECTRICAL AND ELECTRONIC COMPONENTS

Toroid Inductors

New "Type P" coils, wound on molybdenum-permalloy cores, are encapsulated in tough plastic, withstand minus 55 C. ambient temperature,



boiling salt water, and mechanical shocks. Electrical characteristics same as older steel-cased models.—*Hycor Co., Inc.*, 11423 *Vanowen St., North Hollywood, Calif.*

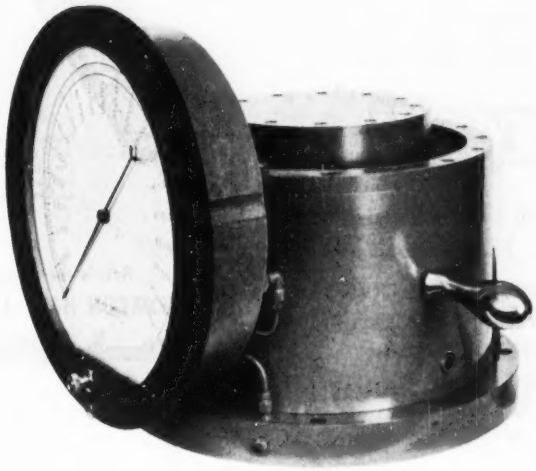
Mention No. 612 when filling out card.

D-c. Ammeter Shunts

New d-c. ammeter shunts, designed for use with 50-mv. instruments, range from 150 to 10,000 amperes, are calibrated to within 0.5 percent accuracy,

NOW!

A *NEW* PORTABLE, SELF-CONTAINED FORCE MEASURING SYSTEM . . .



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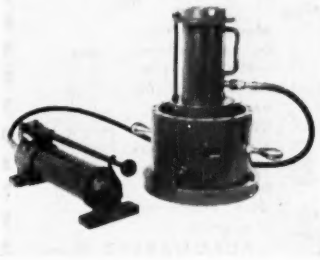
An EMERY hydraulic weighing system, with its new, one-man portability, brings laboratory accuracy to your toughest weighing job. It is weather-proofed, unaffected by temperature or moisture, for use anywhere in your plant or out on the job. Accuracy to 0.1% of range in any position. Stocked for 30 day delivery in capacities from ¼-ton to 50 tons, this self-contained unit needs no prepared base; needs no electrical, no air, no hydraulic connections. You can set up a weighing station anywhere . . . in seconds!



Stock units are also available with one or several indicators mounted in portable, weatherproof cases.

Hydraulic jack, up to fifty ton capacity, mounted on the load-bearing surface of an EMERY portable cell converts the weighing unit into a force *metering* unit . . . applies an accurately measured force in any direction.

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These irons feature better balance for reduced operator fatigue. Efficiency is stepped up, and quality of work is improved. The ideal iron for inaccessible and intricate jobs.
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Capacities: (0-200 in. lbs.) or (0-150 ft. lbs.)

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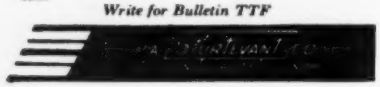

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Model HN Numbering Machines —Hand Style. All numbers on each wheel.
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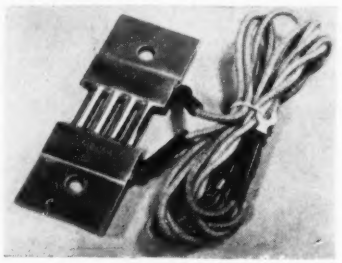
NEW INSTRUMENTS



complete with 10-foot calibrated leads. Each shunt is designed to maintain its accuracy at 100 percent overload, making it usable at twice rated capacity with 100-mv instruments. Owing to solid copper ends and solid manganin rods, accuracy is maintained at maximum capacity and at ambient temperature to 350 F.—*Rapid Electric Co., 2881 Middletown Road, Bronx 61, N. Y.*

Mention No. 613 when filling out card.

Transistors

New line of point contact transistors is announced. Various types will

be in full production in June of this year.—*Hydro-Aire, Inc., 3000 Winona Ave., Burbank, Calif.*

Mention No. 614 when filling out card.

Mercury Batteries for Transistor Applications

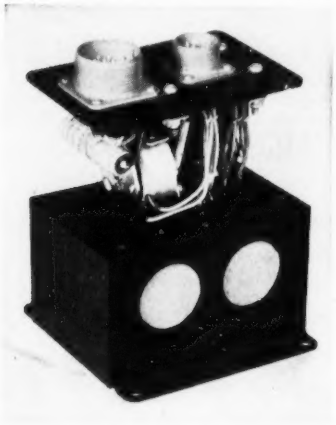
New "Energy Capsules" and "Power-Pak" batteries are tiny low-voltage mercury batteries for junction transistor applications; have new contact

features for better, corrosion-free service. "Power-Pak" batteries are coated with a "shrink-on" plastic to provide leakproof seal between cells. They are said to maintain a substantially constant voltage and energy output level over wide temperature ranges at current drains from 10 microamperes to 10 milliamperes.—*P. R. Mallory & Co. Inc., Battery Division, North Tarrytown, N. Y.*

Mention No. 615 when filling out card.

Circuit Selector

New "Ledex" circuit selector meeting explosion-proof requirements of MIL-E-5272, Procedure 2, comprises a circuit selector in a container having

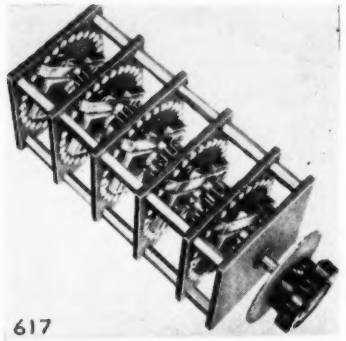


conventional plug type connectors for circuits. Container is made of heavy-gage aluminum with sintered bronze ports. Selector switch assemblies are designed to customers' specifications. —*G. H. Leland, Inc.*, 123 *Webster St., Dayton 2, Ohio.*

Mention No. 616 when filling out card.

Decade-counter Switch

New "Type 410 Decade Counter Switch" designed for remote indication of shaft position has contact panels modified so that rotor arm makes



617

electrical contact every tenth revolution of input shaft. Operation is like that of a counter: first section makes 10 revolutions for 1 rev. of second section, and in turn requires 10 revs to 1 of third section, etc. Thus, five contact panel decades with intermittent gear reduction mechanisms (as illustrated) provides 99,999 switch positions. Unit can operate up to 500 rpm; silver alloy contacts and rotors assure a minimum of two to three million operations.—*Dep't DC, The Daven Co.*, 191 *Central Ave., Newark 4, N. J.*

Mention No. 617 when filling out card.

Magnetic Tape for Measurement Purposes

New "Type 109" magnetic tape (MMM "Scotch" brand) is for data recording, telemetering, computing and other instrumentation purposes; is factory tested and preselected for

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a standard system

of SUPPORT for INSTRUMENT TUBING

Cope INSTROF

★ strong

★ light ★ safe

★ economical

COPE INSTROF is a system of pre-fabricated steel parts that can be quickly and easily assembled and erected in new or old constructions for the continuous support of instrument tubing. It is extremely versatile in application and is adaptable to all needs as standard fittings allow for changes in direction or elevation.

Connectors are secured with nuts and bolts so assembly time is held to a minimum. Hot dip galvanizing of all parts assures long life.

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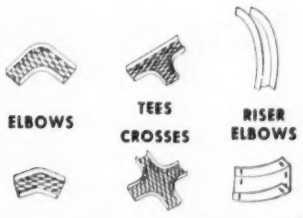

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and other necessary fittings

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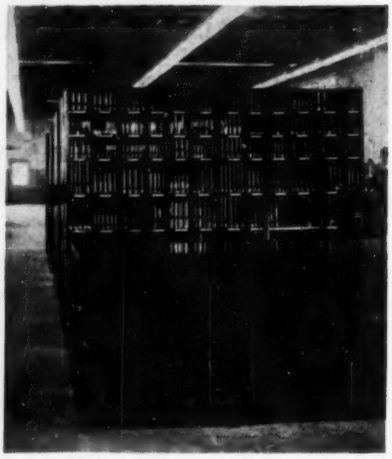

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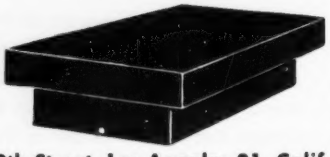
Present an absolute continuous bearing surface, finished up to 50 millionths inch. Incredibly smooth. Falling objects do not cause humps. Being harder than hardened steel, can take greatest mistreatment without causing inaccuracy of surface. No oiling. Will not rust or warp. No re-scraping. Most durable.



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RACK MOUNTING MODELS

105-125 V, 60C INPUT

OUTPUT CURRENT MAY BE SET AT ANY VALUE BETWEEN 0.2 AND 100 M.A. D.C. INCLUSIVE.

AS LOAD VOLTAGE VARIES BETWEEN 0-150 V. MODEL 2A-R IS CONSTANT WITHIN 1%, MODEL 2B-R WITHIN 0.1%.

ELECTRONICALLY REGULATED
D.C. CONSTANT CURRENT POWER SUPPLIES

OUTPUT CURRENT IS HELD CONSTANT AS LOAD VARIES

OTHER MODELS AVAILABLE
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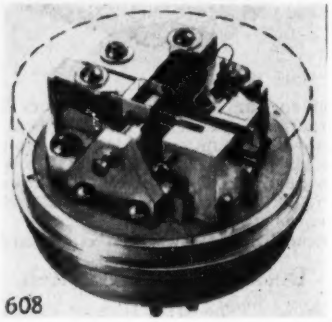
minimum count of nodule or surface imperfections; is shipped in hermetically sealed containers; comes in 0.25-in., 0.5-in., 0.75-in. and 1-in. widths up to 4800 ft. in length.—*Instrumentation Div., Audio & Video Products Corp., 730 Fifth Ave., New York 19, N. Y.*

Mention No. 618 when filling out card.

H-f. Impulse Relay

New "Type T" high-frequency impulse relay has a pull-in time of 120 microseconds and a drop-out time of 100 usec. which enables it to follow 2,500 cycles per second; aperiodic to 1,000 cps. In a typical application it has a life expectancy following a run-in period of one million operations) of five billion operations with a 0.75-ma. contact load over a 6-month period without readjustment. To combine extremely high speed, no-bounce and other characteristics required, it is said, "the development of techniques never before employed in the manufacture of relays."—*C. P. Clare & Co., 4719 W. Sunnyside Ave., Chicago 30, Ill.*

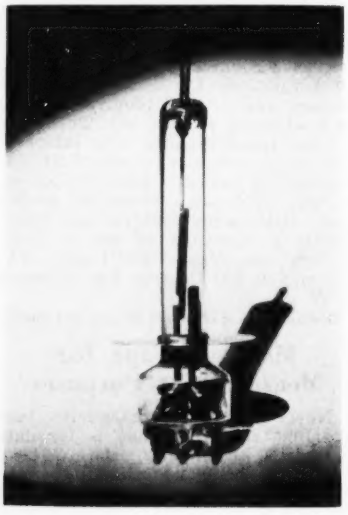


608

Mention No. 619 when filling out card.

High-vacuum Relay

New "PS-32" high-voltage high-vacuum relay with externally-operated d-c. solenoid is 4.5 in. high. It has 300-amp. peak pulse current rating, pulse duration of 3 microseconds and

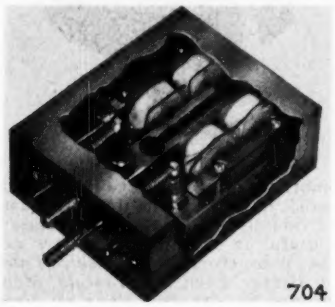


15-*G* vibration characteristic. Lower portion can be hermetically sealed directly into pulse-forming network case, transformer or other oil-filled device. Unit may be specified for use in explosive atmospheres and high-altitude application.—*Pioneer Electronics Corp., Santa Monica, Calif.*

Mention No. 620 when filling out card.

Tuning-fork Resonator

New "Model J" miniaturized tuning fork resonator weighs 8 oz.; has high effective *Q* (approx. 10,000); is available in any frequency from 400 to

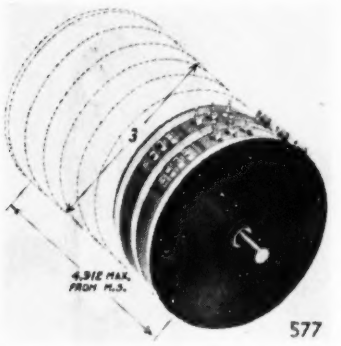


2,000 cps. and in accuracy rating of either 1 part in 10,000 or 1 part in 2,000 for operation from −40 C. to 85 C. Units are completely temperature-compensated, solder-sealed and evacuated.—*Philamon Laboratories Inc., 5717 Third Ave., Brooklyn 20, N. Y.*

Mention No. 621 when filling out card.

Continuous-rotation VDR

New "L Series" of 360-deg. continuous-rotation 3-in.-OD high-precision voltage-dividing resistors supersedes "Model F Helipot," includes "Model L" with bushing mounting and sleeve bearings, "Model LS" with servo lid



mounting and Oilite bearings, and "Model LSP" with servo lid mounting and ball bearings. "Models L and LS" with standard linearities of 0.5 percent in resistance ranges from 10,000 to 100,000 ohms are ready for immediate delivery. Other versions with linearities as high as 0.1 percent (5000 ohms and above) made to order.—*Helipot Corp., South Pasadena, Calif.*

Mention No. 622 when filling out card.

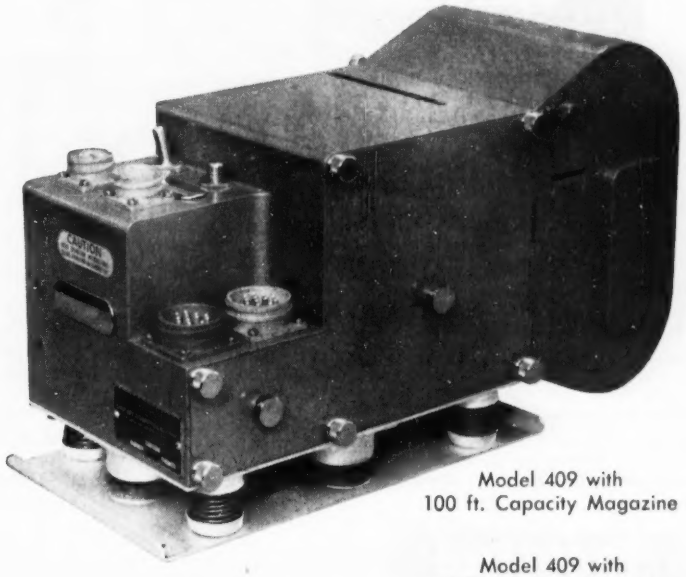
Pulse Transformer

New "Type PT-2 Labtrans" pulse transformer, for use in microsecond and fractional microsecond ranges, is built in an octal tube base. Windings

Century MODEL 409

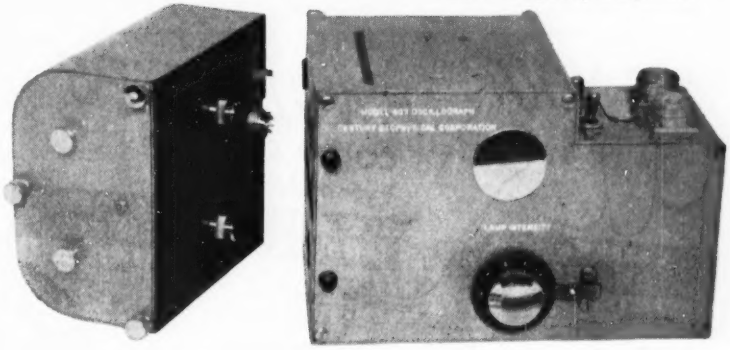
RECORDING OSCILLOGRAPH

FOR VIBRATION, TEMPERATURE, STRESS, STRAIN ANALYSIS



Model 409 with
100 ft. Capacity Magazine

Model 409 with
50 ft. Capacity Magazine



The Century Model 409 Oscillograph was designed for operation under the most adverse conditions and more especially, where space and weight considerations are limited.

This Oscillograph is the smallest and most compact unit available on the present market, yet it incorporates many features found in larger oscillographs, such as trace identification, trace viewing, continuously variable paper speeds and others. The Model 409 Oscillograph has been tested and proven to record faithfully during accelerations in excess of 20 g's. This makes it especially desirable for uses such as missile launching, parachute seat ejection, fighter aircraft and torpedo studies.

Write for Bulletins CGC-303 and CGC-301

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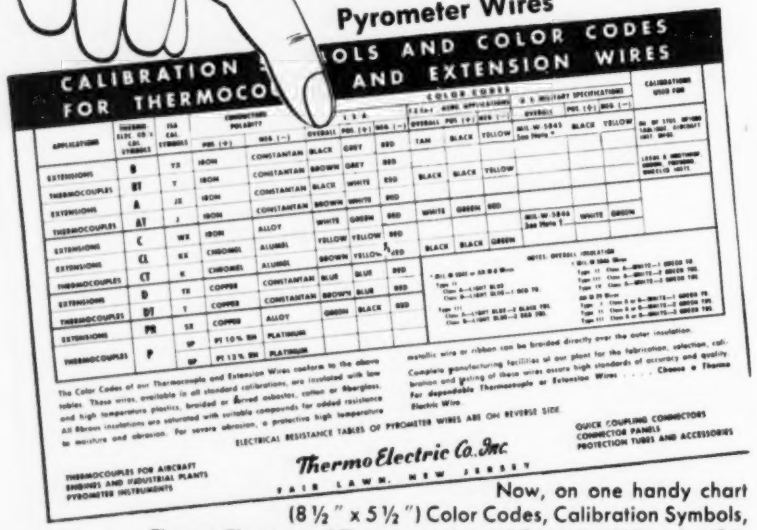

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comprise six sections: two pairs connected in series, other two sections individually connected to base pins. It is useful in blocking oscillators and other pulse circuits.—*Berkshire Labs., 550 Beaver Pond Rd., Lincoln, Mass.*

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Transistor Transformer

New ultra-miniature transistor transformers, said to be world's smallest, weigh less than 0.1 oz., are no larger than the transistor they are designed to power.—*Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.*

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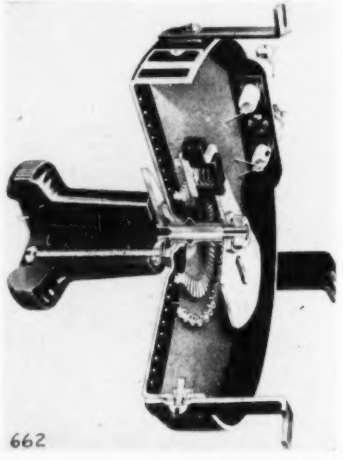
Industrial Rheostats

New "Bulletin 60A Vitrohm" pressed steel rheostats for industrial control applications are characterized by lower operating torque and more



control steps than previous designs. Two types, "S" (standard) and "M" (multi-step), available in 6-, 8- and 13-in. diam.; maximum summation watt ratings 330, 450 and 1000; control steps from 41 to 161 per plate; wide range of resistance values and current tapers. Numerous accessories and optional features for manual or motor-driven operation.—*Ward Leonard Electric Co., Mount Vernon, N. Y.*

Mention No. 625 when filling out card.

Power Rheostats

New power rheostats have been added to maker's line. Sizes now available: 50, 75, 100 and 150 watts, each in a wide range of resistance values. Feature is extra-deep ceramic core on which resistance wire is toroidally wound and bonded in place with vitreous enamel for good heat dissipation and conservative power rating. Special types with tapered windings, mounting and shaft assemblies, tandem units, enclosures, etc.—*Tru-Ohm Products*, 2800 *Milwaukee Ave., Chicago* 18, *Ill.*

Mention No. 626 when filling out card.

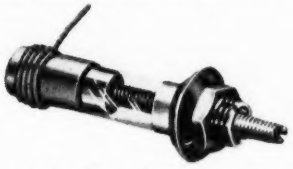
"Knee action" Rotor Arm for Attenuators and Switches

New molded "Knee-Action" rotor, for use on maker's 1.75-in. diameter attenuators and switches, has low-loss phenolic enclosure which protects operating mechanism, prevents tampering in field use, and provides greater insulation between contacts and ground. Silver alloy contact springs operate independently of each other. —*Dep't MH, The Daven Company*, 191 *Central Ave., Newark* 4, *N. J.*

Mention No. 627 when filling out card.

Piston-type Variable Trimmer Capacitors

New continuously-variable trimmer capacitors have one-piece spring-loaded piston and screw made of invar



(extremely low thermal expansibility); silver band fused into surface of drawn quartz or glass serves as stationary electrode. Three models, 0.5 to 12 mmf.—*JFD Mfg. Co.*, 6101 16*th Ave., Brooklyn*, 4, *N. Y.*

Mention No. 628 when filling out card.

Subminiature Metal-clad Capacitors

New subminiature metal-clad capacitors have silicone end seals which provide maximum resistance to thermal and physical shocks and permit soldering up to bushing without seal damage. One series has a solid dielectric; units are for operation from minus 55 C. to 125 C. without derating; meet all military requirements; can be operated at full voltages up

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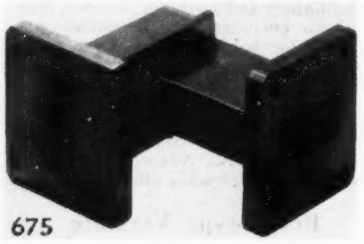
to 50,000 feet altitude. Second new line has a liquid dielectric; units are for operation from minus 55 C. to 85 C. without derating; are 20 percent smaller than comparable oil-filled units. Both lines supplied in either tab or exposed foil designs in ratings from 0.001 to 1.0 muf in voltages of 100, 200, 400, and 600 volts d-c. working.—*Capacitor Dep't, General Electric Co., Hudson Falls, N. Y.*

Mention No. 629 when filling out card.

"Twist-&-turn" Elbow

New "twist & turn" elbow is an "X" band component which combines functions of 90 deg. elbow and 90 deg. twist section. New engineering mod-



ification increases power-handling capacity and improves bandwidth. It is available in RG 51/U, RG 68/U, RG 52/U, and RG 67/U waveguide, with arm lengths and terminations to customer's specifications.—*General Precision Lab., Pleasantville, N. Y.*

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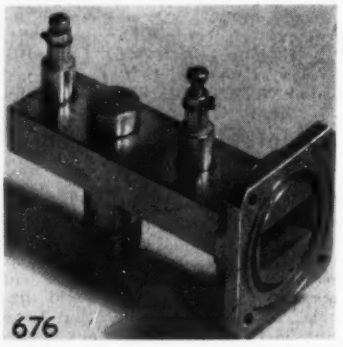
Crystal Detector

New tunable crystal detector, in RG-52/U (illustrated) or RG-6S/U waveguide, is designed for range 8500

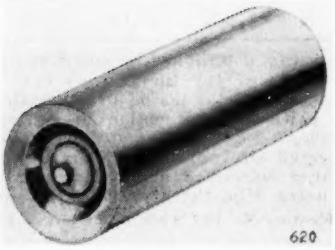


to 9500 Mc.; utilizes two screws for adjusting to optimum VSWR. Simplicity of design and ease of operation are said to represent an advance over earlier crystal detector designs.—*General Precision Lab., Pleasantville, N. Y.*

Mention No. 631 when filling out card.

Ultrasonic Delay Lines

New "Fused Quartz Ultrasonic Delay Lines" are devices in which electric energy is converted into sound energy, passed through fused quartz, and reconverted into electric energy by means of piezoelectric quartz trans-



ducers bonded to either or both ends. Present frequency range is from 5 to 100 Mc.; delay time values from 5 to 1500 microseconds; stability 2 percent between minus 35 and plus 85 deg. C.—*Bliley Electric Co., 200 Union Station Bldg., Erie, Penna.*

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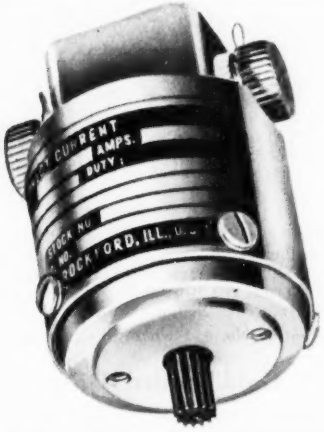
Permanent-magnet Motors

New permanent-magnet motors feature a completely symmetrical armature winding said to provide true electrical balance, superior commuta-



tion, low radio noise interference, "and 25 percent higher efficiency than other known windings." Speeds obtainable range from 5,000 to 20,000 rpm. Motors for 6 to 115 volt d-c. operation can be supplied. BYLM 40000 frame size 1.5 in. diam. by 2.37 in. long; weight approx. 7 oz.—*Barber-Colman Co., Rockford, Illinois.*

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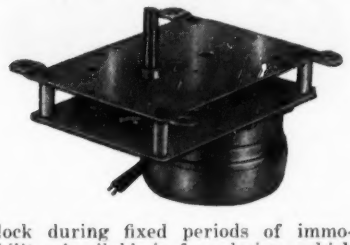
Intermittent-rotation Electromechanical Drive

New "Stop-N-Go Timing Machine" features gear which produces constant speed during motion and a positive



lock during fixed periods of immobility. Available in four designs which produce 3, 4, 5 or 6 stop-and-go motions per revolution with number of

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.018 x 1.5	35,000 ohms	82,290 ohms	229,600 ohms

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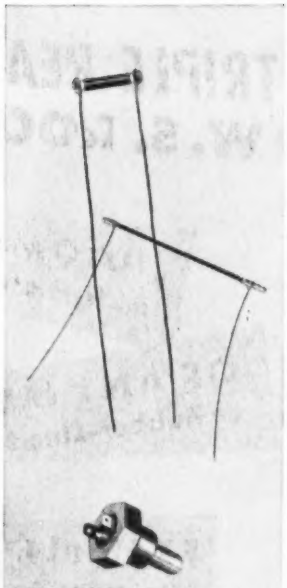

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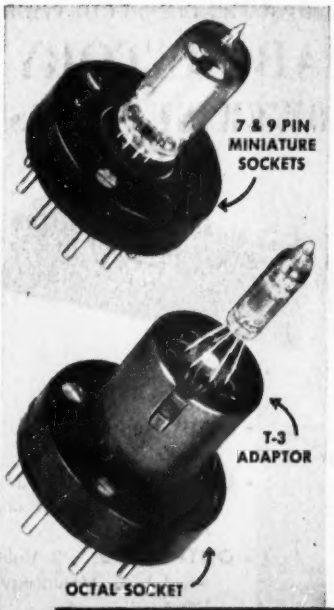

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Now you can test subminiature tubes in octal test rack sockets! The Sylvania subminiature tube adaptor plugs into a standard octal socket. This unique test adaptor features a movable locking ring which assures excellent lead-to-contact union.

Sylvania now manufactures a complete line of test rack sockets designed especially for production testing of radio tubes. These sockets are available for 7- and 9-pin miniature tubes and octal tubes. Made of general-purpose phenolic: insulator and contacts are ruggedly constructed to withstand many tube insertions and withdrawals. For complete details write Sylvania Electric Products Inc., Dept. 3A-4204 Warren, Pa.

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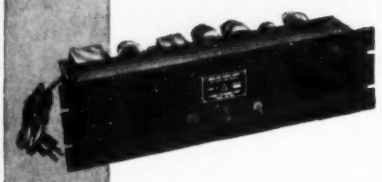

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MODEL 28 STANDARD RACK MOUNTING

PANEL SIZE 5¼" x 19" WEIGHT 16 LBS.

- **INPUT:** 105 to 125 VAC, 50-60 cy
- **OUTPUT #1:** 200 to 325 Volts DC at 100 ma regulated
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- **RIPPLE OUTPUT:** Less than 10 millivolts rms

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intervals determined by speed of motor: almost any timing cycle can be provided. Total period of immobility is twice time for motion: in a 6-sec. cycle, 4-sec. "stop" and 2-sec. "go." Overall size approx. 3.25 in. x 2 in. Motor delivers 8 in.-oz. at 1 rpm.—*Hansen Mfg. Co., Princeton, Indiana.*

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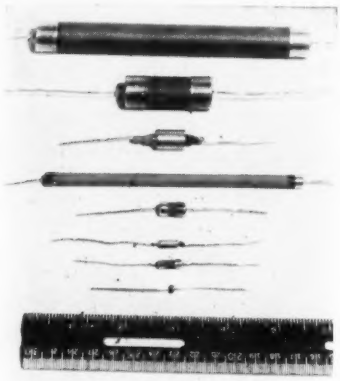
Miniature Selenium Rectifiers

New miniature selenium rectifiers have an ambient temperature range of minus 55 C to plus 100 C. At 35 C,



single-stack rating ranges from 0.5 ma. d.c. at 26 volts rms. to 25 ma. d.c. at 5200 volts rms. Higher ratings result from combining stacks.—*General Electric Co., Schenectady, N. Y.*

Mention No. 635 when filling out card.

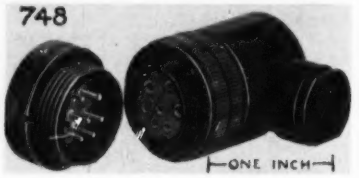
Gold-bonded Diode

New gold-bonded germanium diodes feature back resistance greater than 1 megohm at 100 volts inverse, as well as high forward conductance; are mechanically interchangeable with clip-in types; have inert humidity-protective filling; are also available in standard grades.—*Transitron Electronic Corp., 407 Main St., Melrose, Mass.*

Mention No. 636 when filling out card.

Pressure-tight Connector

New "CR5-2-R" multi-contact miniature electrical connector is for applications requiring mechanical protection with pressure-tight features

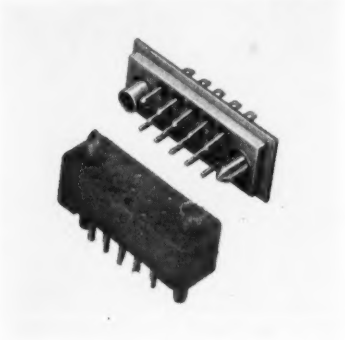


(leakage less than 1 cu.in./hr. at 30 psi. pressure differential). It has individual neoprene seal rings around each contact and between molded body and die-cast aluminum housing; contacts are precision-machined and gold-plated over silver.—*Dep't I, Winchester Electronics, Inc., Glenbrook, Conn.*

Mention No. 637 when filling out card.

Hermetic-seal Connector

New "Series H20" hermetic sealed plugs, added to line of "Continental Precision Connectors," are available in 14 and 20 contacts for No. 20 AWG



wire; will mate with "Series 20" receptacles and have a voltage breakdown of 750 vdc. at 60,000 feet altitude and 3000 vdc at sea level normal conditions.—*DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.*

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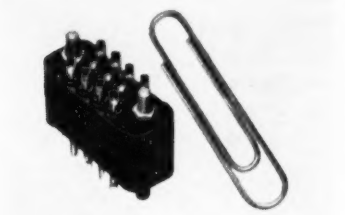
Subminiature Connectors

New "Series SM20" subminiature rectangular connectors are available in 11, 14, 20 and 34 contacts for No. 20 AWG wire, feature 30-percent



physical size reduction without reducing contact-pin diameter which remains 0.04 in. New unit withstands same severe operational abuse as "Series 20" Connectors.—*DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City. N. Y.*

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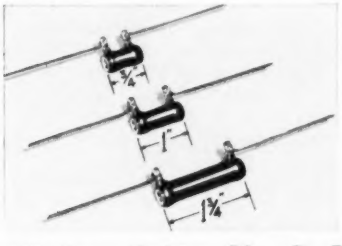
Enamel-coated Resistors

New line of enamel-coated power resistors is designed specifically for requirements of radio and television



applications.—*Resistor Div., P. R. Mallory & Co., Inc., Frankfort, Indiana.*

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- 9999.9 hour range
- 10,000 hour automatic reset
- −55 to +55°C. operating temperature.

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DIAL THERMOMETERS GAUGES AMMETERS

Measurement of Air Pollution

by W.C.L. Hemeon, J. Deane Sensenbaugh, and George F. Haines, Jr.
Mellon Institute

Solid air pollutants are more difficult to analyze than gas pollutants, primarily because no one instrumental method can apply to both fine and coarse particles. Basic techniques and the state of the field are presented for both solid and gas pollutants. The concepts of the "invisible" coarse particle and the "massless" fine particle are of particular interest.

AIR pollution requires measurement both at the source (the stack) and at ground level or the location where the effect is produced. Air pollutants can be classified as gaseous or solid. The first part of this discussion is about the solids, the commonest of which is coal smoke.

Coarse and Fine Particles

The solids discharged from almost all stacks are particles. Small particles have diameters of a fraction of a micron; large ones have diameters of several hundred microns. (The micron is 0.001 mm.). City atmospheres also contain such particles. It is useful to classify all air- or gas-borne solids into two broad classes: fine particles and coarse particles, and to ignore intermediate sizes. The advantage in such a classification is seen from the basically different properties of each group (Table 1).

Table 1.—Physical Properties of Particles

Coarse	*Fine*
"Rains" by gravity onto horizontal surfaces.	Deposits on wall and ceiling surfaces, not by gravity.
Has mass. Accounts for all the weight in mixtures.	Has no mass. Contributes no weight, mixed with coarse.
No power for scattering light. Hence invisible in air suspension.	Scatters light to high degree. Visibly prominent in air suspension.

Presented at the Conference "Instrumentation for the Iron & Steel Industry," April, 1952, Pittsburgh, Pa.

The distinction between coarse and fine particles is made without any reference to particle size because the important consideration is some property of the pollutant, not its micron size. Thus, coarse material is defined as that material which is deposited by gravity onto horizontal surfaces, whereas fine material is deposited on wall and ceiling surfaces independently of gravity. (It is deposited on horizontal surfaces also, but is imperceptible there in comparison with deposits of course material.)

Weight Properties

The second item in the table indicates that coarse material has weight and fine material is weightless. This is not true literally, but Figs. 1 and 2 show that it is true practically. Fig. 1 is a model representation of various sizes of particles in an ordinary dust-smoke mixture. Fig. 2 shows that almost all the weight of the mixture is caused by the larger particles, even though their number is insignificant. Note that the curves in Fig. 2 cover only particles of 12-micron diameter and smaller. Addition of the single 50-micron particle would account for 97 percent of the total weight and yet not affect the number curve at all. Thus coarse particles can be said to have mass, and fine particles can be said to be "without mass."

For these reasons, weight-concentration measurement of dust in gaseous suspension gives only the weight of the few largest particles in a sample; this is true regardless of the absolute size of the largest particles. In an outdoor measurement, the weight concentration in air suspension reflects only the air-pollution nuisance commonly referred to as dust fall—the gravity deposition of solids on horizontal

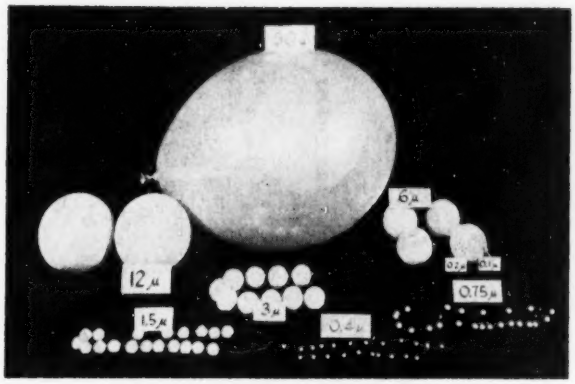

Fig. 1. Model representation of 100 particles in a smoke-dust mixture, illustrating particle-size distribution.

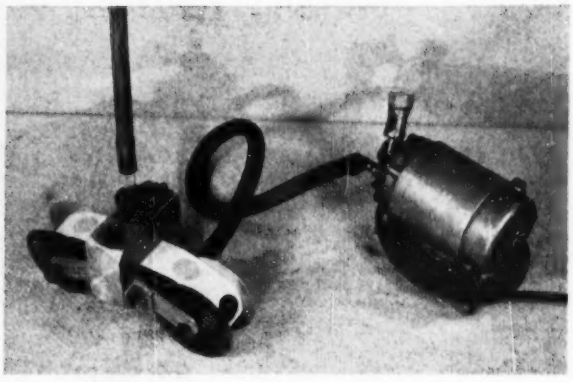

Fig. 3. Arrangement for aspirating stack gases through filter paper.

surfaces- -which is primarily caused by large particles. If the pollution effect being explored is caused by small particles, weight measurement is worthless because the small particles contribute insignificantly to the total weight.

Light Scattering

Light scattering is enormously increased as the fineness and number of particles increases. Scattering by fine particles is great; in comparison, light scattering by coarse particles is insignificant. This is why plumes at the top of stacks caused by discharges of fly ash from coal-burning installations do not seem to be dense, whereas the discharge of fine fumes from open hearth stacks or coal smoke from improper combustion of coal is extremely prominent. Table 1 therefore indicates that coarse particles are "invisible," a somewhat exaggerated description but almost literally true.

Measurement Methods

As shown in Table 2, separate measurement methods are required for coarse and fine particles—one based on weight, the other based on light-scattering potential.

Table 2.—Measurement Methods

Coarse	*Fine*
Weight determination. Rate of deposition, or air concentration (weight).	Light scattering or absorption. Either in air suspension or after surface deposition.

Light Scattering for Fine Particles

The common photoelectric instruments for indicating the amount of smoke in stack gases provide an index to the quantity of fine particles present. Another method includes aspirating the gases through filter paper for a given interval and then evaluating intensity of the resulting stain by measurement of reflected light or transmitted light, or by visual evaluation of color (blackness, for example). Fig. 3 shows an equipment in which a strip of filter paper can be shifted into position, manually, for succeeding tests. The pump aspirates stack gases through a tube to the filter and a flowmeter.

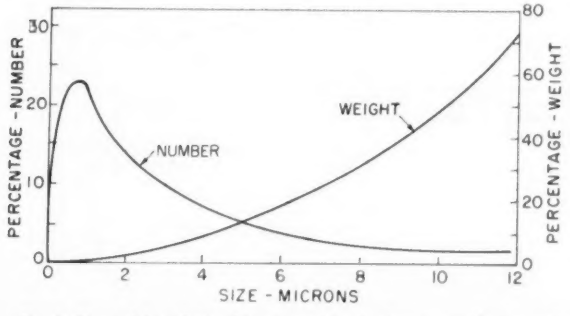

Fig. 2. Size-weight relationship of particles in Fig. 1, considering only particles below 12-micron size.

This method is used in measuring the efficiency of electrostatic air filters. The spots are evaluated on the basis of relative blackness, using a blackness scale for rating. However, as the color of the spot is often not truly black, a better basis is provided by measuring light reflectance or light transmission. Light transmission is easily measured by the apparatus in Fig. 4, which consists of a light source, a light-sensitive cell in front of which the stain is placed, and a milliammeter indicator; light measurement through a clean area of the paper represents 100-percent transmission.

The amount of light transmitted through the stain is a function of the light-scattering ability of the particles on the stained filter.

Light reflectance measurements could be employed instead of light transmission; apparatus is commercially available but expensive. Comparative measurements made in collaboration with Mr. William Wilson of the Cleveland Health Department (who uses a light reflectance instrument for similar purposes) do not indicate that one method is superior to the other.

Light Intensity and Particle Weight

Fig. 5 is a striking illustration of the fact that there is no relation between light-scattering potential and mass of particles. Dusty stack gases were aspirated through a chamber in which 85 percent of the weight of dust settled out by gravity; the remaining 15 percent (by weight) of the gas stream was passed through a filter paper. Simultaneously, a dusty gas sample from which no dust had settled out was passed directly to another filter paper. As shown in Fig. 5, the light transmission values are practically the same, illustrating the fact that the coarse particles have almost no light-scattering power in comparison with that of the fine particles.

Automatic Stack-smoke Samplers

An automatic sampler for obtaining a record of this type is the Von Brand filtering recorder (Fig. 6). In this instrument the filter is moved slowly and continuously over a suction orifice. This produces a narrow strip record of the concentration of fine particles.

There are no automatic samplers available at this writing for evaluation of coarse material in stack gases. This is unfortunate because the coarse particles are practically invisible and contribute importantly to the air-pollution problem of cities. The tools for measuring weight concentration of solids in stack gases are manual ones, and steel engineers are familiar with them. Procedures involve aspirating a sample of stack gases into a sampling tube at the same velocity as prevails in the stack or flue, and passing it to a suitable filter for subsequent weighing.

Sampling at Ground Level

In spite of the occurrence of the Donora smog nothing is known about how day-to-day air pollution affects health. Positive allegations made on this matter are entirely un-

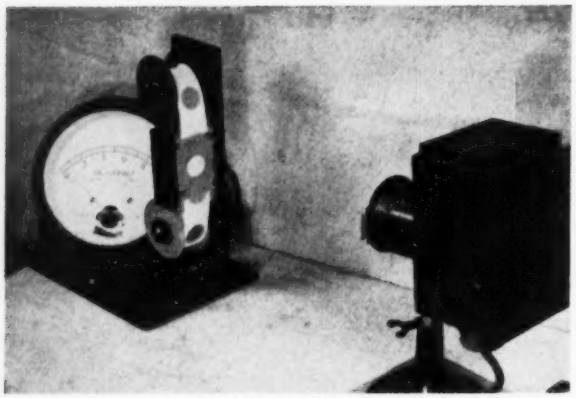

Fig. 4. Measurement of light transmission for analysis of filter-paper staining.

supported by factual data. This immediately indicates that there is no routine chemical sampling and analysis of the atmosphere, as distinguished from physical measurements. In the absence of information as to the significance of the chemistry of outdoor air pollutants it follows that the measurements to be made must be physical ones. The classification of solid particles and their relative properties apply to ground-level measurements as well as to stack gases. However, another factor—the weather—should be taken into account in planning instrument use.

Meteorological Influences

It is now known that the concentration of air pollution near the ground is markedly affected by local weather conditions, particularly the natural ventilation. This ventilation has two components, horizontal wind currents and vertical wind currents. The magnitude of the latter depends on differences in air density caused by temperature changes at different elevations. These vertical air currents are as important as the horizontal winds in dispersing and dissipating the air pollution.

The weather also affects the quantity of air pollution being discharged from combustion processes. For example, lower temperatures or higher wind velocities in winter time result in greater quantities of fuel burned, both in private homes and central power plants; the result is greater quantities of coal dust, smoke, or ash being discharged.

A better understanding of air-pollution problems demands the development of tools and techniques for surveying the relation between air-pollution intensities and weather conditions over short time periods.

Owens Smoke Filter

The original use of filter paper in an instrument for measuring the concentration of fine particles, or smoke staining power, in outdoor atmosphere can be credited to the late J. S. Owens; the Owens Automatic Smoke Filter has been used widely in Great Britain.

Davidson[1] employed the Owens filter principle in his 1940 study of air pollution in New York City, the most outstanding study of its kind that has been conducted in this country.

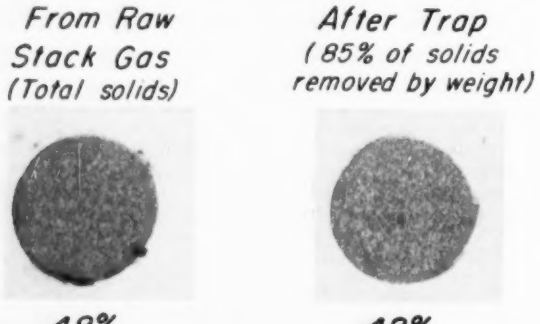

Fig. 5. Comparative light transmission of two samples, from one of which 85 percent of solids was removed (by weight).

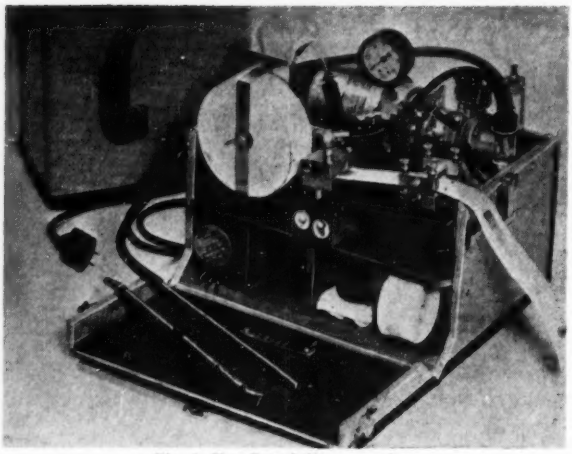

Fig. 6. Von Brand filter recorder.

The high-frequency sampling schedule of the Owens Automatic Filter (two to five times per hour) discloses interesting characteristic variations in hourly smoke intensity. In Fig. 7 this variation is shown in data reported by Owens, by W. F. Davidson, and by our laboratory. Although obtained years apart (over 25 years) and in different parts of the world, the similarity is striking.

Of most importance, the patterns of diurnal variation in concentration suggest that a simplified sampling schedule could be incorporated in the design of an automatic instrument. For example, sampling periods of six hours would bracket logical time periods of consistently low, medium, and high pollution intensity—early morning starting around midnight; late morning ending at noon; an afternoon period; and a late evening period.

The great advantage in reducing the sampling frequency is illustrated by the experience of Davidson whose eighteen months' survey produced 200,000 samples in the form of 1/8-inch-diameter filter-paper spots; he devised a special calculator to analyze that massive quantity of data.

A. I. S. I. Automatic Smoke Filter

With these factors in mind we designed an instrument (Fig. 8) whereby spots of larger diameter than in the Owens apparatus are obtained. We also designed for simplicity and low cost so that large numbers of such instruments could be used around an area without bankrupting the instrument budget.

Air is aspirated at a rate of approximately 1/4 cu. ft. per minute through a one-inch-diameter circle of filter paper

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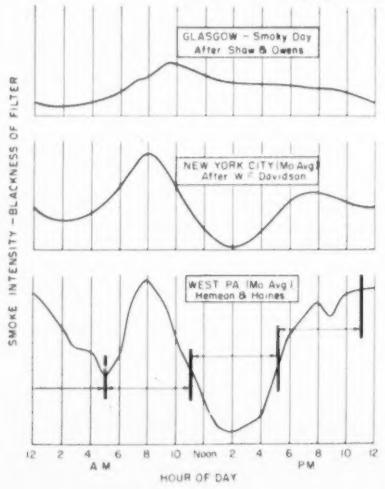
GLASGOW – Smoky Day
After Shaw & Owens
NEW YORK CITY (Mo Avg)
After W. F. Davidson
WEST PA. (Mo Avg.)
Hemeon & Haines
SMOKE INTENSITY – BLACKNESS OF FILTER
12 2 4 6 8 10 Noon 2 4 6 8 10 12
A.M.
P.M.
HOUR OF DAY

Fig. 7. Diurnal variations in smoke intensity at various locations.

Steel Industry Water Instrumentation

In treatment, use, and disposal of water in the steel industry, instruments can (1) reduce operating and supervisory labor requirements, (2) minimize treating-chemical requirements, (3) insure uniformly better-quality water, and (4) protect water-using equipment. The points in the water system where instruments should be employed are described.

By
CHARLES F. HAUCK AND EDWARD C. EGER
Hall Laboratories

INSTRUMENTS have been used for many years to indicate, record, and control flow, pressure, temperature, and liquid level at various points in water-treatment plants. More recently, devices for measurement and control of pH value, specific gravity, electrical conductivity, and oxidation-reduction potentials have been used. Refinements which add, subtract, multiply, divide, and average quantitative signals from multiple detecting devices also have enlarged the scope of instrumentation in water treatment, use, and disposal.

The recent trend toward higher steam pressures, with a number of steel plants now operating boilers at 1000 psi., makes it necessary to condition the feed water and boiler water to obtain improved water quality and to hold the various concentrations of suspended and dissolved solids within narrow limits.

Instrumentation is an essential part of water-plant design. Variations in rate of flow and changes in concentration of raw water of variable character greatly affect the controllability of the treatment process. The controllability, in turn, has an important influence on the design criteria for the treatment units. For example, an oversized control valve or an undersized supply line, or a reaction tank susceptible to short-circuiting, can nullify the effectiveness of an otherwise good control system. For these reasons instrumentation should be considered as an integral part of the original water-treatment layout rather than as an adjunct thereto. Of course, instrumentation often can be added with advantage to an existing plant.

Presented at the Conference "Instrumentation for the Iron & Steel Industry," April, 1952, Pittsburgh, Pa.

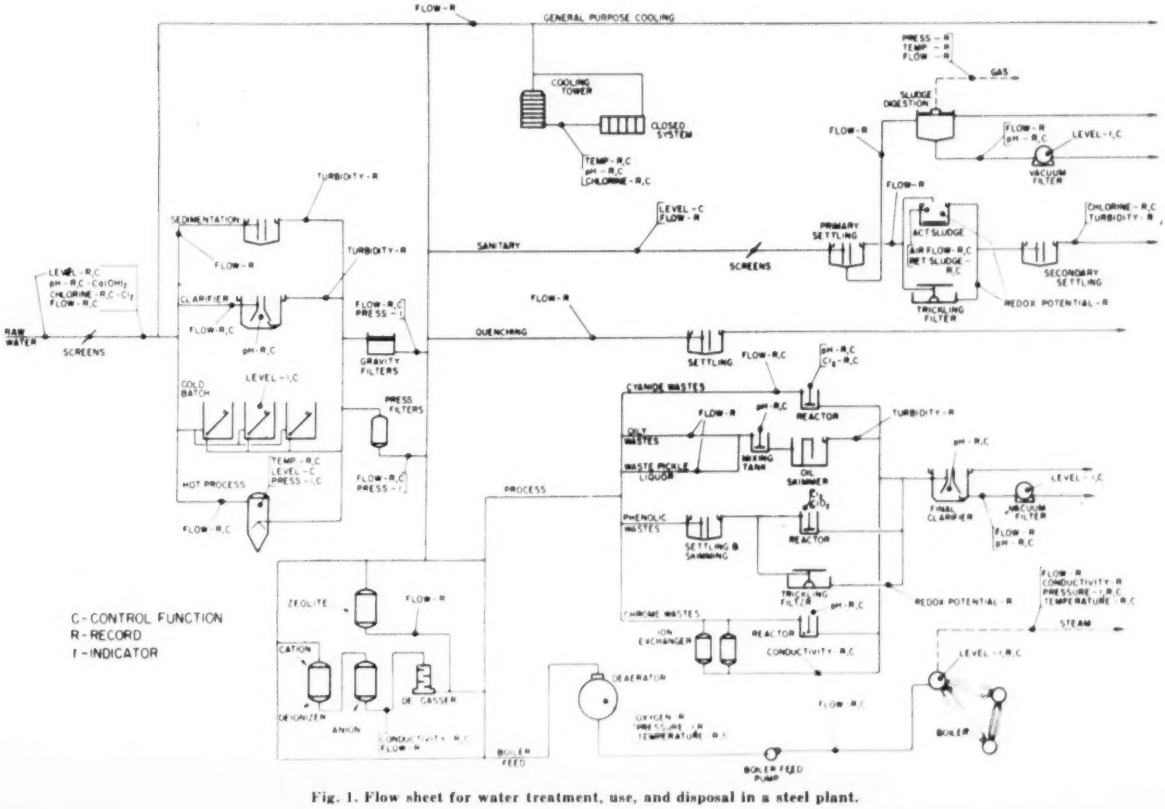

Fig. 1. Flow sheet for water treatment, use, and disposal in a steel plant.

Instrument application to water-conditioning processes can result in many advantages: (1) reduction of supervision and operating labor requirements for a given process; (2) a batch operation often can be transformed to a continuous process which requires much less labor and space; (3) beneficial effects on water quality and treatment chemical requirements (instruments which operate on a time cycle or those which respond automatically to stimuli from changes in the water can hold treatment-chemical consumption to a minimum); (4) reduction of human error—for example, buildup of sludge and scale deposits in boiler tubes can occur when hand-operated intermittent feeding of protective chemicals is loosely done. Internal boiler conditions have been improved markedly in many plants by installing chemical feeding systems controlled by timers or flow meters.

Instrumentation for treatment, use, and disposal of water may be considered from the standpoint of either (1) the variable measured or controlled, such as flow rate, temperature, pH value, conductivity, turbidity, etc., or (2) the specific use, such as screening, neutralization, sedimentation, filtration, cooling, etc. This article discusses the need and advantages of adequate instrumentation for the steel-plant water system.

Fig. 1 is a flow sheet showing some key points and typical units of equipment for water treatment, use, and disposal in a steel plant. Table 1 shows the variables which should be controlled in order to attain proper operation of water-treatment units.

Flow

Water Treatment

Sufficient flow-measuring instruments should be used at various points so that water balances, material balances, and heat balances can be maintained on operations which affect plant water quality, usage, or disposal.

Except in rare instances where water and power are plentiful and cheap, it is advantageous to measure the total water intake to a plant. Where the water is subsequently treated in a sludge blanket, slurry pool, or sludge recirculation-type unit, a meter on the intake line is almost essential to govern the feeding of the treating chemicals. When using an accelerated clarification or softening unit (or traditional flash mixing, flocculation, and clarification procedure) metering to control chemical dosage and to provide operating records is highly desirable.

In the operation of hot process softeners, chemical feeds are commonly actuated by a flow meter. Fig. 2 shows how a modern method of controlling chemical feed brings about greater uniformity of hardness removal. For a multiple-unit softener installation, flow-measuring instruments are necessary not only to properly proportion chemicals but also to provide the operator with a visual record to assist him in dividing the load equally among the units.

Table 1.—Variables to be Monitored or Controlled at Indicated Points in Water System

	Flow	Temp.	pH	Cond.	Turb.	Alk.	Pres.	Level	Total Hardness	O_2	Cl_2
Plant Intake	X		X				X	X			X
Plain Sedimentation	X				X						
Rapid Clarifier	X		X		X						
Cold L-S Cont.	X				X	X			X		
Cold L-S Batch						X		X	X		
Hot L-S	X	X			X	X	X	X	X	X	
Filters-Open	X				X			X			
Filters-Closed	X				X		X				
Zeolite	X						X		X		
Demineralizer	X		X	X			X		X		
Deaerating Heater	X	X					X			X	
Cooling Tower	X	X	X		X						X
Oil Skimmer	X	X	X		X			X			
Aerator	X		X								
Trickling Filter	X									X	
Sludge Digester	X	X						X			
Dewatering Filter	X		X		X		X	X			

Note: Temp. — Temperature, Cond. — Conductivity, Turb. — Turbidity, Alk. — Alkalinity, Pres. — Pressure.

Both gravity and pressure filters should be individually equipped with flow indicators or loss-of-head gauges so that satisfactory through-put rates can be assured when the units are on stream or being backwashed. This is especially true for pressure filters. For example, a crack in the bed of a pressure filter can cause serious short-circuiting unless it is fitted with flow indicators to detect such an undesirable and abnormal condition. Even under ideal operating conditions it is difficult to properly divide the influent among several filters without a flow indicator on each unit. Good flow control through gravity filters also can be obtained with float-operated valves in the effluent lines. For this purpose the filter effluent discharge line frequently is carried into a weirbox and fitted with a float-operated valve. By changing the orifice plate in the weirbox, various maximum rates of filtration can be set.

It is advantageous also to record the total amount of water that is filtered by a battery of filters. A recording meter to show total filter backwash water provides a handy record for noting the flow rate, time, and duration of backwash operations.

Each unit in a zeolite softener or deionizer should be equipped with a flow indicator and integrator. Where the quality of influent water is reasonably consistent, automatic backwashing and regeneration of zeolite softening and deionizing units based on flow measurement is practical. Where the quality of influent water varies to such a degree that automatic regeneration based on flow alone becomes impractical, conductivity can be employed as the controlling variable in the regeneration of deionizing units.

Photoelectric-cell arrangements have been used to detect the presence of constituents which, on addition of a reagent, produce color or turbidity and thus determine the endpoint of a run on a zeolite bed.

A recent article entitled "Instrumentation in Water Usage" by E. L. Streatfield in the British publication *Chemistry & Industry* described a method for controlling automatic regeneration of zeolite softeners based on hardness of the effluent. Samples taken continuously from a point at or just above the bottom of the zeolite bed are treated with a constant amount of standard soap solution. This treated sample is led to a photoelectric-cell chamber that is normally balanced against a second photoelectric cell whose chamber receives a portion of sample not treated with soap solution. When hardness breakthrough causes turbidity in the treated sample, the cells are thrown out

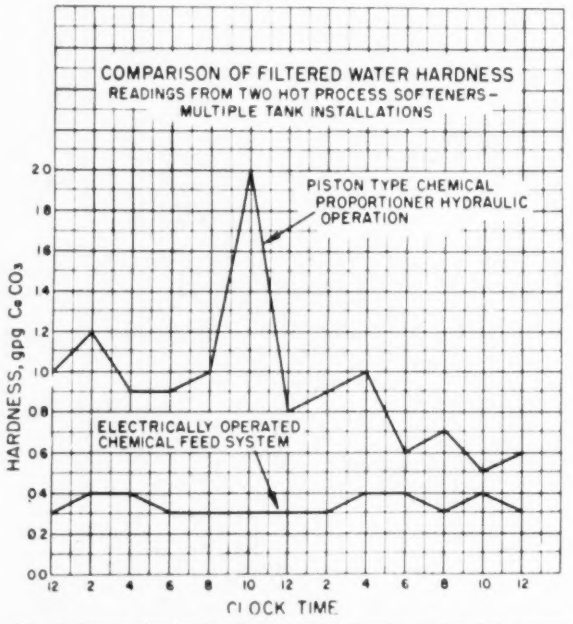

Fig. 2. Curves showing hardness of filtered water in two hot process softeners (multiple-tank installations).

of balance and a signal is transmitted to an automatic control system to start regeneration of the zeolite unit.

Cooling Water

For cooling applications, flow regulating devices actuated by changes in effluent temperature (and occasionally flow measurement devices) should be installed. This is especially true in plants where total water costs including pumping, treating, and other expenses are significant.

Process Water

Water used for processing purposes also should be measured and controlled where the supply of water is limited or where the cost is relatively high. Under such conditions the restriction of flow through continuous rinse tanks can be justified to avoid unnecessary wastage of water.

Waste-water Treatment

Just as the raw or purchased water entering a mill should be metered, the contaminated water entering the waste-treatment plant also should be metered. Where activated sludge treatment is employed, sewage flow to the aeration tanks, air, and returned sludge flows should be recorded also. Furthermore, the rate of supplying air to the sewage should be governed by a ratio controller actuated by a flow meter. It is desirable in activated sludge plants to proportion sludge return to through-put rate.

Where a number of raw waste-water streams enter an industrial waste-treatment plant, each stream should be metered and recorded.

Sludge from the primary and secondary tanks in a sewage treatment plant is commonly digested in heated sludge digestors. It is advisable to measure the flow of gas from the digestor, sludge to and from the digestor, and the supernatant from the digestor. After the sludge has been digested it is usually dewatered. For good control of sludge filtration it is advantageous to meter the quantity of sludge filtered and the amount of filtrate discharged.

Steam Generation

In steam-generation plants it is important to measure feed water and steam flow for numerous reasons. A visual record permits the operators to check the performance of the feed water and boiler system. Chemical feeds to the boilers can be governed by water or steam flow. In recent years three-element feed-water control has become popular in high-pressure steam plants. The boilers in such installations are generally of exceptionally high capacities with a maximum steaming rate which could dewater a boiler completely in a few minutes. The three-element system controls the feed-water input by balancing the rates of flow of steam and feed water, with final correction from indications of boiler drum water level.

pH Value

Water Treatment

Table 2 lists ranges of pH which have been found effective for the water-treatment processes noted.

It is common practice in many localities to adjust the pH of the incoming raw water at the plant intake. The adjusted pH value is usually near 7 (neutral), but the actual control point frequently is selected on the basis of the experiences of the plant's maintenance department.

Adjusting the pH requires feeding either an acid or an alkali, depending on the character of the raw water. It is advantageous to use a pH recorder and controller to govern the chemical addition because underfeeding or overfeeding the neutralizing chemical can damage the piping and equipment; highly acidic water causes corrosion whereas water which is too highly alkaline lays down deposits. Poor control of chemical additions to raw water also can complicate and interfere with the operation of treatment units, such as lime-soda-ash softeners and clarifiers, which use the adjusted raw water.

pH recording and control are desirable also on sludge blanket, slurry pool, or sludge recirculation units being employed for clarification or softening of raw water. Table 2 shows that controlling the pH during coagulation and flocculation is very important if maximum clarity of effluent is to be attained.

Table 2.—Typical pH Value Ranges for Water-treatment Processes

Coagulation:	Ferrous Sulfate	8.5 - 11.0
	Ferric Sulfate	4.0 - 11.0
	Ferric Chloride	4.0 - 11.0
	Aluminum Sulfate	5.5 - 8.0
	Aluminum Chloride	5.5 - 8.0
	Sodium Aluminate	5.5 - 8.0
	Magnesium Oxide	10.3 - 10.8
Softening:	Cold lime-soda ash	9.5 (min.)
	Hot Process	9.5 (min.)
	Sodium cycle ion exchange (Green Sand)	8.0 (max.)
	Sodium cycle ion exchange (Sulfonated Coal)	9.0 (max.)
	Sodium cycle ion exchange (Phenolic Resin)	8.5 (max.)
	(Styrene Resin)	No Limit
		7.3 - 8.7
Neutralization:	For corrosion control of raw water	6.0 - 8.0
	For degasification	Approx. 7.0
	For pollution abatement	5.0 - 8.5
Silica Removal:	Ferric Sulfate	9.0 - 9.5
	Magnesium Oxide	9.8 - 10.2
Boiler Feedwater:	For bronze feed pumps	4.0 - 6.0
	For bronze-iron feed pumps	6.0 - 9.0
	For iron or steel feed pumps	9.0 (min.)
	For economizers	9.0 (min.)
Boiler Water		10.5 (min.)
Hydrogen Sulfide Removal:	Aeration	4.0 - 5.0
	Ion Exchange	7.0 - 9.0
Destruction of Cyanides by chlorination		8.5 - 10.0
Destruction of Phenol by chlorine		7.0 - 10.0
Reduction of Chromium:	Ferrous Sulfate	1.0 - 2.5
	Sulfur Dioxide	Approx. 3.0
	Sodium Metabisulfite	4.0 - 5.0
Sludge digestion		6.8 - 8.0
Sludge filtration:		4.5 - 6.5

When recarbonation of lime- or lime-soda-ash-softened water is practiced, the feed of carbon dioxide should be controlled by a pH instrument within narrow limits to minimize after precipitation from alkaline water or corrosive attack by acidic water. Furthermore, in large installations, automatic control of recarbonation supervised by a pH instrument can result in significant fuel economy in operating the carbon-dioxide generator.

In a plant treating water for process use by coagulation and sedimentation, it was found that most effective flocculation with alum occurred at pH 5.8. Initially, chemical feed for pH adjustment was set by the operators based on pH determinations made at 2-hour intervals. As is the case in an ever-increasing number of plants using contaminated surface supplies, fluctuations in the raw-water pH were wide and frequent. As a result the adjustments in chemical feeds for optimum coagulation frequently were out of step with actual conditions because of the time lag between the detection of pH change in the raw water and the compensating change in chemical feed to the coagulation basin. A pH recorder was installed to guide the operators in the direction and rate of change of raw-water pH; the plant now reports a 40-percent reduction in consumption of alum due mainly to elimination of overfeeds. Additionally, the filters are cleaner and the treated water is uniformly of better quality.

Cyanide & Chrome Wastes

The importance of the pH recorder and controller in the treatment of cyanide and chrome bearing wastes can hardly be exaggerated. When copperas is used to reduce chrome from the hexavalent to the trivalent state before precipitation, the optimum pH for the reduction is between 1 and 2.5. When sulfur dioxide is used as a reducing agent, the optimum pH for the reduction is approximately 3.0. We have studied the cost of reducing hexavalent chromium with sodium bisulfite at various pH levels.

Similarly, in the oxidation of soluble cyanides by the alkaline chlorination procedure, hydrogen-ion concentration (pH) is important from two standpoints: If the pH is not high enough, much chlorine will be converted to nitrogen trichloride which is very irritating to the eyes and the respiratory system. On the other hand, if an excessively high hydroxide concentration is maintained, substantial chlorine is wasted and, in some instances, alkali as well.

Continued on page 596

Control of Chemical Processes

By
A. J. YOUNG*

Part four in this series on automatic control of chemical processes presents the basic factors associated with temperature control by two-step action, including possible situations, conditions for successful control, and multi-step control.

Two-step Control of Temperature

The basic principles which have been illustrated in considering two-step level control now can be applied to temperature control.

The Process Reaction Curve

A valuable quantitative idea of the ease or difficulty of controlling any process can be obtained by drawing curves, known as process reaction curves, to show the variation of controlled condition (in the absence of control) due to (a) supply changes and (b) load changes.

In discussing level control, it has been seen that the following information can be obtained from these curves:

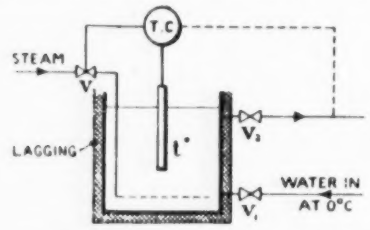

Fig. 4-1. Temperature-control system in which water is heated by steam injection.

(1) The mean rate of change of controlled condition (r).

(2) The initial value of r, which determines the response of the controller at the commencement of the disturbance.

(3) The inherent regulation of the process.

Example (i). Consider the vessel in Fig. 4-1, in which water is heated by steam injection. Let valves V_1 and V_2 be closed so that, if the vessel is well lagged, there are no appreciable heat losses. Then if steam is injected the rate of rise in temperature will be constant and proportional to the steam rate, as shown by curves a and b in Fig. 4-2.

Example (*ii*). Next let valves V_1 and V_2 be opened, so that water flows into the vessel at a rate (Q), is heated through t degrees, and flows out carrying away heat at a rate equal to Qt. If we could hold the amount of heat (Qt) constant, the change in temperature of the water in the vessel would still be linear with time as in Fig. 4-2, curve a, and a change in steam rate would merely alter the rate of temperature change, curve b.

Note. (*a*) If the specific heat of the condensed water is insignificant in comparison with the latent heat of the steam, the transfer of heat from steam to the water in the vessel does not depend on the temperature of the water—that is, heat is added irrespective of the water temperature at a constant rate, just as water added to a tank at constant rate gives a constant rate of rise of level.

(*b*) There is no transfer lag in the process because there is no thermal resistance, or loss of heat depending on a temperature difference.

The time which elapses while the temperature of the water is being raised by the required amount is due to the finite rate of supply of heat (as steam) and to the thermal capacity of the water.

Example (*iii*). Next take the more practical condition in which the heat (Qt) taken from the system is not held constant. We now have conditions analogous to Fig. 3-11 for level control, and so we shall expect inherent regulation. The function of the two-step controller is to hold the water in the vessel at t degrees so that the incoming water leaves at t degrees. After equilibrium has been established, let a supply disturbance occur in the form of an increased steam pressure upstream of V_2, and consequent increased steam supply. The extra heat-supply rate will increase the water temperature, but not linearly because the loss of heat is no longer constant but proportional to the temperature of the water. The process reaction curve for a supply change is therefore as shown by the dotted curve in Fig. 4-2.

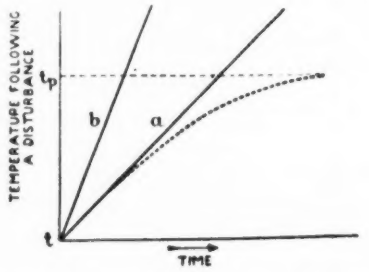

Fig. 4-2. Temperature of water in Fig. 4-1 for various conditions.

Note. (*a*) In the absence of control, the final temperature attained would be the "potential temperature" (t_p) such that the extra heat supplied equalled the extra heat lost, (Q) ($t_p - t$). The "potential deviation" due to the supply change is ($t_p - t$).

(*b*) The system possesses inherent regulation, which will assist the controller; if ($t_p - t$) is small, inherent regulations is large.

(*c*) The reaction rate is initially the same as in (*a*), and hence no disadvantage to the controller is introduced at the beginning of the change.

(*d*) The shape of the dotted curve in Fig. 4-2 is typical of that produced by a transfer lag.

If C is large, changes due to supply disturbances will be slow, and if Q is large the inherent regulation will be high for supply disturbances. Hence control will be stable for suppy variations.

*Technical Department, Imperial Chemical Industries, Ltd., London. This series of articles originally appeared in the *Industrial Chemist*, England.

Example (iv). Assume now that Q increases by $\triangle Q$, giving a load change. The extra rate of heat supply required is $(\triangle Q)(t)$. The temperature t will commence to fall exponentially towards the potential value of temperature corresponding to the disturbance. Here again a large value of C will prevent rapid changes; the greater the inherent regulation, the less the potential change will be in the absence of control.

These considerations indicate that a system of the type of Fig. 4-1 with a large demand-side capacity, and considerable inherent regulation, presents an easy temperature-control problem. The shape of the process reaction curve at the commencement of a change is favorable.

Two-step control therefore can be applied safely in such a system.

Systems with Several Capacities and Resistances

In many applications, however, there are several capacities and resistances and, consequently, several sources of transfer lag. The two most common sources are (a) supply capacity with heat transfer resistance between supply and demand, and (b) detecting-element transfer lag.

The steps for eliminating the latter have been discussed and should be taken in all temperature-control systems; they are especially unfavorable for two-step control. The former are inherent in the plant design and are also unfavorable to two-step control.

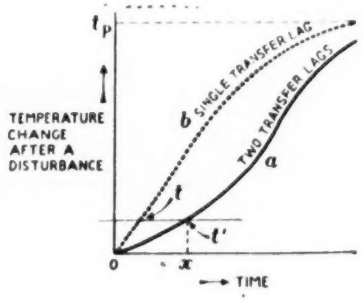

Fig. 4-3. Effect on process reaction curve of transfer lags introduced by both supply-side capacity-resistance and demand-side capacity-resistance.

The two-capacity-resistance level-problem discussed previously can usually be avoided, but the analogous temperature problem cannot be avoided. In general it is better to apply a continuous method of control to systems with several capacities and resistances.

Fig. 4-3 shows the effect on the process reaction curve of transfer lag introduced by a supply-side capacity and resistance, in addition to transfer lag due to demand side. The initial slow change (ox) is the main trouble because while the disturbance is "coming through" to the demand side, the supply disturbance (masked by the slow initial change) remains only slightly corrected. In two-step control the departure from desired value would be detected at a time given by the curve (a) at time t', considerably later than t if curve (b) had applied. Hence overshoot will occur. The control obtained after a demand change is shown in Fig. 4-4 for a system with two transfer lags.

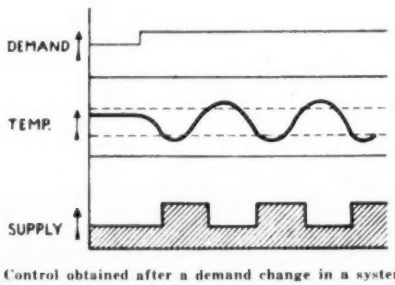

Fig. 4-4. Control obtained after a demand change in a system with two transfer-lags.

Note. (i) Any measuring lag will increase the difficulty of control and result in greater overshoot.

Distance-velocity lag, such as would be given in the system of Fig. 4-1 if the detecting element were placed some distance along the outflow pipe (as shown dotted), can be avoided usually by correct positioning of the detecting element.

(ii) It is important to remember that measuring transfer lag causes the measuring unit to read *low* during any cyclic disturbance of the controlled condition. It is therefore possible for the controlled temperature to deviate seriously outside the high and low limits due to this cause alone. If the measuring unit operates a recorder the same error will be made in the record which is therefore useless for showing whether or not the controller is keeping the temperature within the required limits. Not only should transfer lag in the measuring unit be reduced to the minimum, but the rate of cycling also must be reduced as far as possible. The lower the rate of change of controlled condition, the less will be the error due to transfer lag in the measurement.

Conditions for Successful Two-step Control

The magnitudes of capacities, lags, and changes in supply and demand in the plant determine the success of the installation. Large capacity on the demand side and small capacity on the supply side, together with low value of lags, (especially transfer lags) make for good control. Two-step control can be used in these conditions.

Measuring and controller lags are as important as process lags and the best condition is when one lag is much larger than the rest. The worst condition arises when the total transfer lag is made up of a number of approximately equal lags. If two or more considerable transfer lags exist, two-step control should not in general be used.

Large changes in supply or demand make it impossible to set the regulating unit with high and low values suitable for covering the whole range of possible changes.

Multi-step Action

To meet the need for more flexibility to deal with wide fluctutations of supply and demand, multi-step action is sometimes used. It is defined as (Definition 2410): A control action in which predetermined control actions take place in two or more chosen values of the controlled condition. Fig. 4-5, reproduced from the B.S.I. Glossary of Control Terms, illustrates the action.

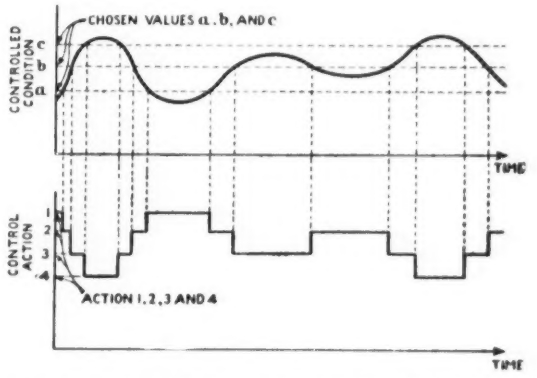

Fig. 4-5. Multi-step control, in which control action takes place at chosen values (a, b, and c) of the controlled condition.

Examples of Plant Use of Two-step Control

(1) *Level*—Stock tanks and feed tanks; surge vessels; bottom product level in continuous stills (usually proportional action is used).

(2) *Temperature*—Small furnaces with electric or gas heating and large continuous furnaces where the load is nearly constant; preheaters and oil and salt baths; batch processes in which the chemical action is not strongly exothermic or endothermic and when the temperature is not critical. Many batch processes fall into this category. Tanks and baths, such as are used for plating, etc., where changes in demand are small.

(3) *Pressure*—Where pressure is not a matter of flow control, *e.g.*, air compressor and receiver.

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READINGS OF DIFFERENTIAL PRESSURE in three meter runs, static pressure, and downstream pressure are made by Bristol Metameter Transmitters at the Northeastern Gas Transmission Company's station at West Lebanon, New York. The readings are multiplexed and sent over a single telephone circuit to Springfield, Massachusetts, over 50 miles away, where they are recorded on separate Metameter receivers.

NINE BRISTOL METAMETER RECEIVERS in Northeastern's main office in Springfield record differential, static, and downstream pressure readings sent from West Lebanon, N. Y., and static pressure readings sent from Concord, Haverhill, Malden, and Arlington, Mass. A static pressure reading at Greenwich, Conn., is transmitted over a single telephone circuit to a Metameter receiver at Springfield. Flow through meter runs at West Lebanon is controlled by Bristol Differential Controllers remotely set at the Springfield office.

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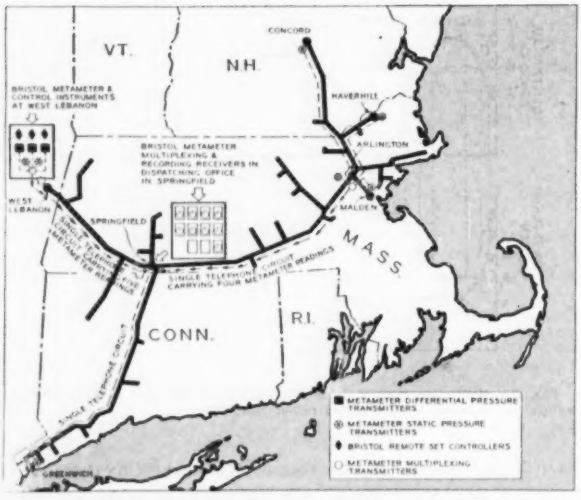

MAP SHOWING Bristol Metameter MULTIPLEXING Telemeters on Northeastern Gas Transmission Co.'s pipeline.

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INSTRUMENT SOCIETY of AMERICA Journal

National Office: 1319 Allegheny Avenue, Pittsburgh 33, Pa., P V. Jones, Jr., Society Manager.

Vol. 9 APRIL, 1953 No. 4

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By Taft Wrathall

Section Secretaries, Meeting Data and Programs

AKRON
Russell F. Marquardt, 1782 Tonawanda Ave., Akron 5, Ohio. Tel: ST-6865
Fourth Tuesday, Meeting 8:15 P. M., U. of Akron, Ayer Hall, Rm. 212-B.
May 26, 1953—Social Night—"Monte Carolo"

ALBUQUERQUE
C. F. Cox, 209 Gen. Hodges, Rd. N. E., Albuquerque, N. M.
Second Thursday, Meeting at 8:00 P. M., Mitchell Hall, Univ. of New Mexico.

ARUBA
M. A. Davidson, P. O. Box 452 c/o Lago Oil & Transport Co. Ltd., Aruba, N. W. I., 2087.
First Tuesday, 7:30 P. M., Engr's Club.

ATLANTA
M. Virgil Davis, 357 Sixth St., N. W. Atlanta, Ga. Tel. EM. 3042
Fourth Friday, Meeting 7:30 P. M., Electric Bldg., Georgia Power Co.

BALTIMORE
G. B. Greer, 631 East 36th St., Baltimore 18, Md. Tel: CHesapeake 6879
Second Friday, Meeting at 8:30 P. M., Engr's. Club of Baltimore.

BATON ROUGE
Thomas J. Folendore, 1540 Keed Avenue, Baton Rouge, La. Tel: 3-5567
First Monday, 7 P.M. Baton Rouge Trade School Winbourne & N. 33rd St.

BLUE RIDGE
David C. Moore, Box 425 B RFD #4, Roanoke, Va.

BOSTON
Robert V. Meyer, Box 111, S. Lincoln, Mass.
Fourth Wednesday, Dinner at 6:30 P. M. Meeting at 7:30 P. M., 99 Club, 99 State St.

CALIFORNIA
Robert W. Fulwider, 5225 Wilshire Blvd., Los Angeles 36, Calif.
Second Wednesday, Dinner at 6:30 P. M. Meeting at 8:00 P. M.

CAROLINA PIEDMONT
H. M. Messenger, 436 Sedgefield Rd., Charlotte, N. C.
Second Friday, Dinner at 7:30 P. M., Meeting at 8:30 P. M. Cardinal Restaurant, Charlotte, N. C.

CENTRAL ILLINOIS
Thomas A. Carroll, 721 Hurlburt St., Peoria, Ill., Tel: 4-8909
Second Wednesday, Some dinner meetings at 6:30 P. M., Meeting at 7:30 P. M.

CENTRAL INDIANA
Leon Stewart, Rock Island Refining Corp., P.O. Box 6091, Indianapolis, Ind. Tel: CO-2377
First Tuesday, Dinner at 7:00 P.M. Business Meeting 8:00 P.M. McClarney's Famous Restaurant, 1435 West Morris St.

CENTRAL NEW YORK
C. M. Davies, 213 Beechwood Ave., Liverpool, N. Y. Tel: Syracuse 3-0252.
Third Monday, Dinner 6 P. M. Meeting at 8 P. M. General Electric Auditorium or Solvay Process Library.

CENTRAL OHIO VALLEY
J. C. Dilliner, 813 Winton Ave., Belpre, Ohio. Tel: Belpre 87596
First Tuesday, Dinner at 7:30 P. M., E.S.T., Hi-Way Grille, Rt. #2, about 3 miles south of St. Mary's, W. Va.

CHARLESTON
J. A. Rothwell, 310 24th St., Dunbar, W. Va.
First Monday, Dinner at 6:15 P. M., Meeting at 8:00 P. M., Kanawha Airport Terminal Bldg.

CHICAGO
Floyd E. Ertsman, Rm. 1420, Fisher Bldg., 343 S. Dearborn St., Chicago 4, Ill. Tel: WE 9-0686
First Monday, Dinner at 6:30 P. M., Meeting at 8:00 P.M. Hotel Shoreland, Chicago, Ill.

CHINA LAKE
Beuhring W. Pike, 606-A Essex Circle, China Lake, Calif. Tel: 77782
Third Thursday, Meeting at 8:00 P. M., Michelson Lab., USNOTS, Conference Room.

CINCINNATI
E. J. Geiser, 3666 Hubble Rd., Cincinnati 24, Ohio Tel. Ja. 5618.
First Monday, Dinner at 6:30 P. M., Meeting 8:00 P. M., Engineering Soc. of Cinn.

CLEVELAND
M. M. McMillen, Thompson Products, 2196 Clarkwood Ave., Cleveland, Ohio
Second Wednesday, Dinner at 6:30 P. M. Meeting at 8:00 P. M., Cleveland Eng'r. Society, 2136 E. 19th St.

COLUMBUS
Kenneth I. Lea, Battelle Institute, 505 King Ave., Columbus 1, Ohio Tel: UN-3191, Ext. 247.
Third Thursday, Meeting at 8:00 P. M. Battelle Auditorium

CUMBERLAND
Clyde Babst, 225 Cecelia St., Cumberland, Md. Tel: 583-W
Fourth Wednesday, Dinner at 6:30 P. M., Meeting at 8:00 P. M.

DENVER
Karl F. Kent, Jr., 5030 Umatilla, Denver 11, Colo. No regularly scheduled meetings. Univ. of Denver, Science Bldg.—Campus

DETROIT
R. A. Hoxie, Basic Service Corp., 14016 Woodrow Wilson, Detroit 6, Mich.. Tel: TO-88043
Third Wednesday, Meeting 8:00 P. M., Rackham Memorial Bldg., 100 Farnsworth, Detroit, Mich.

EASTERN NEW YORK
Robert W. Carter, Sterling-Winthrop Research Institute, Rensselaer, N. Y. Tel. Albany 5-6251 Ext. 262
First Tuesday, Meeting at 8:00 P. M., Siena College, Loudonville, N. Y. Optional Dinner at 6:00 P. M., Circle Inn, Lathams, N. Y.

FOX RIVER VALLEY
John R. Redgrave, 159 S. Appleton St., Appleton, Wis.

HOUSTON
A. Costa, 6209 Edloe St., P.O. Box 6614, Houston, Texas.
Last Monday 8 P.M. U. of Houston Library

KALAMAZOO VALLEY
Jack M. Fettig, 433 Thomas St., S.E. Grand Rapids, Michigan.
Fourth Wednesday, 8:00 P. M., Dinner at 6:30 P. M. Meeting at Red Arrow Legion Post, 2431 W. Michigan Ave., Kalamazoo, Mich.

KANSAS CITY
Donald D. Baker, 5823 Mission Rd., Mission, Kansas
First Tuesday, Meeting at 7:30 P. M., U. of Kansas City, Science Bldg., Rm. 106.

LAKE CHARLES
A. T. Clinger, Columbia Southern Chemical Corp., P. O. Box 900, Lake Charles, La. Tel. 6-7522
First Wednesday after last Monday, Dinner and regular meetings at McNeese State College

LOUISVILLE
O. Vern Spousta, 2000 S. Brook St., Louisville, Ky.
First Monday, Meeting at 8:00 P.M., Seagram Auditorium.

MONTREAL
W. L. Toohey, Dominion Textiles Ltd., 1950 Sherbrooke St., West, Montreal, Tel. GI 5711
Last Monday of Month, Meeting 8:00 P.M., Mechanics Institute

MUSCLE SHOALS
Atherton Hastings, Tennessee Valley Authority, Div. of Chemical Engineering, Wilson Dam, Alabama. Tel: Sheffield 3160, Ext. 6238
First Thursday, Meeting 8:00 P.M., TVA Chemical Engineering Bldg.

NEW JERSEY
Eliot R. Hill, 1125 Kensington Ave., Plainfield, N. J.
First Tuesday, Meeting 8:00 P. M., Essex House Hotel, Newark, N. J.

NEW YORK
R. A. Hutcheon, 45-65 196th St., Flushing 58, N. Y., Tel: BAyside 9-5432
Third Monday, Dinner at 6:00 P. M., Meeting at 7:30 P. M., Midston House, 38th St. & Madison Ave.

NIAGARA FRONTIER
Duran L. Hagler, 214 E. Delavan Ave., Buffalo, N. Y., Tel: ELmwood 1258
Fourth Monday, Dinner at 6:00 P.M. Meeting at 8:00 P.M., N.Y.S. Technical Institute, 1685 Elmwood Ave., Buffalo, N. Y.

NORTH TEXAS
R. E. Byers, 6000 Lemmon Ave., Dallas 9.

NORTHERN CALIFORNIA
Robert L. Norman, 351 42 St., Richmond, Calif. Tel: BE 2-0901
Third Monday, Dinner 6:30 P. M., Meeting 8:00 P. M. Spengers Grotto, 1919 4th St., Berkeley.
April 20, 1953, "Soaring Planes & Gliders" by Fred Matteson, Flight Research Engineer, Ames, Aeronautical Laboratory. Movies

NORTHERN INDIANA
M. J. Duzmal, 10504 Avenue "J", Chicago 17, Ill. Second Tuesday, Meeting at 8:00 P.M., Whiting Community Center, Whiting, Ind.

OAK RIDGE
Thomas M. Gayle, 117 W. Vanderbilt Drive, Oak Ridge, Tenn. Tel: 2-1516.
First Wednesday Meeting at 7:30 P.M., Ridge Recreation Hall

PADUCAH
J. B. Russell, 1407 W. Main St., Murray, Ky.
Second Tuesday, 8:00 P.M.

PANHANDLE
George W. Leggett, 1600 Western Ave., Amarillo, Texas
George W. Leggett, 1600 Western Ave., Amarillo, Texas. Tel: 3-1434
Third Tuesday, Dinner at 7:30 P.M. Phillips Grade School Cafeteria, Phillips, Texas

PERMIAN BASIN
Jack M. Ray, P.O. Box 1262, Odessa, Texas.
Second Tuesday, Dinner at 8 P.M. Tel: 2-2813

PHILADELPHIA
A. S. Chatfield, c/o American Meter Company, 1513 Race St., Philadelphia 2, Pa.
Third Wednesday, Meeting at 8:00 P.M., Bellevue-Stratford Hotel.

PITTSBURGH
Dr. A. H. Peterson, Mellon Institute, 5500 Fifth Ave., Pittsburgh 13, Pa. MA 1-1100
Fourth Monday, Dinner at 6:30 P.M., Meeting at 8:00 P.M., Roosevelt Hotel

PRESQUE ISLE
Edwin P. Schuwerk, 445½ Halley St., L. P., Erie, Pa. Tel: 2-2349
Fourth Tuesday, Meeting at 8:00 P.M., G. E. Community Center, East Lake Rd., Erie, Pa.
April 28, 1953—Election of Officers. Tour of New Penelec Power Plant.

RICHLAND
J. R. Plee, 1309 Roberdeau, Richland, Wash. Tel: 5-8692
Second Wednesday, Meeting at 7:30 P. M., American Legion Hall

ROCHESTER
R. C. Schwarz, Jr., 1201 Granite Bldg., Rochester 10, New York. Tel: Hamilton 1468
Fourth Tuesday, Meeting 8 P.M. U. of R., Bausch & Lomb Physics Lecture Room 109, River Campus

SABINE-NECHES
R. A. Block, 2301 Avenue "G", Nederland, Texas
Last Tuesday, Meeting at 7:30 P. M., Orange County Courthouse, Orange, Texas.

SARNIA
L. J. Hall, 730 Talfourd St., Sarnia, Ont., Canada. Tel: EDgewater 2258.
Third Monday, 8:00 P.M., Y.M.—Y.W.C.A.

SAVANNAH RIVER
F. P. Ledford, Jr., 907 Royalette St. N. Augusta, S. C., Tel: 5-4626
Second Wednesday, Dinner at 7:30 P.M. North Augusta Legion Post.

SEATTLE
Frank S. Melder, 2439 76th N.E. Bellevue, Washington
Second Friday.

SOUTH TEXAS
Homer C. Givens, P.O. Box 637, Falfurrias, Texas. Tel: 202
First Thursday, Engineers Club

ST. LOUIS
W. G. Lee, 4710 Delor St., St. Louis 16, Mo. Tel: FL 8516.
First Wednesday After First Monday, Meeting at 8:00 P.M., Engineer's Club of St. Louis.

TOLEDO
Howard R. Daily, 2025 Scottwood Ave., Toledo, Ohio.
Third Tuesday, Meeting at 8:00 P. M., Service Bldg., Toledo Edison Co.

TORONTO
John W. Huether, 311 Sutherland Dr., Leaside, Ontario, Canada. Tel: HU-7114
Fourth Thursday, Meeting at 8:00 P.M. Friendship Hall, College St. United Church, Toronto

TENNESSEE
James L. Williams, 2237 Bruce St. Kingsport, Tenn. Tel: 2079-L

TULSA
A. J. Sesock, 845 South East Ave., Tulsa, Okla., Tel: 8-1112
University of Tulsa Campus, Petroleum Bldg.
First Monday, Meeting at 7:30 P.M.

TWIN CITIES
John L. Schmidt, 1879 University Ave., St. Paul 4, Minn., Tel: DR 0064
Fourth Tuesday, Dinner at 6:30 P.M., Meeting 7:30 P.M., Rm. 353, Coffman Memorial Union, U. of Minn.

WASHINGTON
Edward C. Lloyd, 2105 Spencer Road, Silver Spring, Md. Tel: SH. 9340.
Third Monday, Meeting at 8:00 P.M., P. E. P. Co. Auditorium.

WAYNE COUNTY
Clarence Ellison, 2443 15th St., Wyandotte, Michigan. Tel: Avenue 2-4178.
Third Monday, Meeting at 8:00 P.M., Larson's Cafe, Lincoln Park, Mich.

WILMINGTON
W. C. Ruglass, 900 A West 8th Street, Wilmington, Delaware
Second Tuesday, 8:00 P.M. Harlan School, 36th & Washington Sts., Wilmington, Del.

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ISA NEWS

1952 Financial Report

by
George R. Feeley
(1952 Treasurer)

George R. Feeley

The Financial Records of the Society have been audited by Mr. J. A. Hollingsworth, a Certified Public Accountant of the State of Pennsylvania. A complete financial statement has been prepared and distributed to Members of the Executive Board, Members of the Finance Committee, National Council Delegates, and Section Presidents. A summary of the Statement of Condition and Statement of Income and Expense follows:

Statement of Condition
December 31, 1952

We Have:	
Cash on hand and in banks	$ 72,590.87
Investments (Gov't Bonds)	30,000.00
Furniture & Fixtures (without depreciation)	7,899.48
Salable Materials (Insignia etc.)	1,107.83
Deferred Expenses	5,716.95
TOTAL ASSETS	$117,315.13
We Owe:	
Accounts Payable	$ 931.50
We have Reserves for:	
Furniture & Fixtures (depreciation)	4,484.25
Salable Materials (previously expensed)	1,107.83
Chicago Exhibit Income	28,955.00
Proceedings (1952 Conference)	390.00
We have as Surplus:	
Previous (Balance January 1, 1952)	67,206.19
Added from 1952 operation	14,240.36
TOTAL LIABILITIES & SURPLUS	$117,315.13

Statement of Income & Expense
January 1 to December 31, 1952

We Received from:	
Dues and Membership Activities	$ 65,447.59
Annual Conference	7,170.20
Exhibit (Cleveland)	94,478.70
Journal Income	3,966.67
Income from Investments	863.00
Miscellaneous Sources	256.75
TOTAL INCOME	$173,182.91
We Spent for:	
Section Refunds and Membership Activities	$ 54,061.69
Annual Conference	17,393.87
Exhibit (Cleveland)	51,062.40
Operation of National Headquarters	34,783.08
Administration	1,641.51
TOTAL EXPENSES	$158,942.55
As a result of this year's operation, we have added to surplus	$ 14,240.36

The Financial Records of the Society are kept at the National Headquarters in Pittsburgh. They are open to the examination of any interested member during regular business hours.—George R. Feeley, Treasurer (1952)

Chester Huffman

It is with deep regret that the National Office learned of the recent death of Chester L. Huffman of the Pittsburgh Section. "Chet" has been a member of the Society since 1946.

George G. Adams - Stanley H. Sye

The New York Section announces with deep regret the death of two of their members, George G. Adams and Stanley H. Sye.

Cleveland ISA Section Active In Tappi Conference

R. J. Carleton, Jr., F. W. Kirk, and G. W. Gard of the Joint Conference Committee of the Cleveland Section of the Instrument Society of America are working with the Lake Erie Section of the Technical Association of the Pulp

G. W. Gard

R. J. Carlton

and Paper Industry, the Cleveland Section of the American Society for Quality Control and the Engineering Division of TAPPI on a two day conference to be held in Cleveland, May 21-22, 1953 at the Hotel Carter.

The subject of the conference is "Measurement and Control of Paper and Paperboard Manufacturer and Conversion . . . Present and Future".

The popular ISA film "Principles of Automatic Control" will be one of the Arm Chair Tours provided by members of the Cleveland ISA Section.

THURSDAY, MAY 21ST

8:00 AM to 9:30 AM
Registration

9:30 AM to 12:30 PM
(1) "Measurements and Controls Presently Available to the Papermaking and Converting Industries — Their Advantages and Limitations"
(2) "What the Papermaker and Converter Would Like To See Measured and Controlled
(3) "Instrumentation from Management's Viewpoint"

AFTERNOON SESSION

2:30 PM to 5:30 PM
(1) "The Instrument Manufacturer's Problems in Meeting the Demands of the Papermaking and Converting Industries"
(2) "Process Controls Presently in Use in Other Industries Which Might Be Applied To the Manufacture and Conversion of Paper and Paperboard"
(3) "Other Industry" Experience in Measurement and Control Which May Be of Benefit to the Paper Industry
(4) The Use of Measurement and Control Devices to Aid the Quality Control of Paper and Paperboard Manufacture and Conversion

7:00 PM to 10:00 PM—Dinner
"The Greatest Measuring and Control Problem of All—The Human Being"

FRIDAY, MAY 22ND

9:00 AM to 12:00 Noon
Plant Tours—Trips through plants in the Cleveland area outstanding for their use of controls
Republic Steel Co.—Automatic control of steel webs at 1000 feet per minute
Ford Motor Company—"The Plant of Tomorrow" Automatic control of the manufacture of Ford engines
Standard Oil Co. of Ohio—Automatic control in one of the largest refineries in the United States
Arm-Chair Tours—Movies
"Principles of Automatic Control"—Instrument Society of America—One hour, color and sound. "Motors in Industry"—General Electric Co.

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ENGINEER. Experienced, for research and development work on electronic self-balancing instruments. Excellent opportunity with large New England manufacturer. State educational background, experience and salary. Location: Waterbury, Connecticut. Box 798.

ENGINEER OR PHYSICIST. With specialized training or experience in frequency response analysis as applied to pneumatic controllers to work in Research Department of manufacturer of industrial controllers. Include resume with reply. Location: Waterbury, Connecticut. Box 799.

SALES REPRESENTATIVE. English Company, long established and well known, manufacturing a wide range of electrical measuring instruments seeks a representative for sale of its products in the U.S.A. Preference will be given to a representative well connected in industry already selling and servicing such products. All applications will be treated in strict confidence by the Managing Director who proposes to visit the U.S.A. in the early spring. Box 800.

PHYSICISTS AND RESEARCH ENGINEERS. The Physics Department of Southwest Research Institute has several permanent staff positions for physicists and research engineers with B.S. or advanced degrees, and 2 to 10 years of experience in acoustics, antenna design, electromechanical transducers, geophysics, nuclear physics, optical instruments, pulse circuits, or servo-mechanisms. Location: San Antonio, Texas. Box 801.

PROCESS CONTROL APPLICATION ENGINEER. For a position with a manufacturer of Process Control Instruments. Experience necessary in Process Control application in the petroleum, petro-chemical, and chemical industries. Electrical engineering background desirable. Some traveling necessary. Please state education, experience, and current salary. Location: Stratford, Connecticut. Box 802.

INSTRUMENT MECHANICS. The Tennessee Valley Authority wants experienced instrument mechanics for work in chemical plants at Wilson Dam, Alabama. The work is inspecting, testing, repairing, adjusting, and calibrating service instruments, including actuating connections and control equipment. Instruments are electrical, mechanical, pneumatic, hydraulic, thermal, or any combination of these. Salary is $4500 per year for 40-hour week. Liberal vacation leave, sick leave, and retirement benefits. Location: Wilson Dam, Alabama. Box 803.

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Plant Control by Gas Analysis

A. W. ANGERHOFER* and B. M. DEWEY**

Abstract. Continuous analysis of gas mixtures is being successfully applied to process control in the production of oxygen, nitrogen, and the rare gases from atmospheric air. Other gas analyzers now in use are readily adaptable to process control.

OCCASIONALLY engineers are confronted with a plant control problem that can not easily be solved by the use of the more familiar controllers, such as flow, temperature, pressure, or liquid level controllers. If the process is one in which changes in composition are taikng place, analysis of the product itself may offer the solution.

The production of oxygen, nitrogen, argon, and neon by liquefaction of air is a process that lends itself to control by gas analysis. Work done by Air Reduction Co., Inc., has led to reliable means of controlling air separation processes by continuous analysis.

During the past two years continuous gas analyzer-controllers have been installed to replace manual control in the production of neon, oxygen, and argon. Not only has plant operation been simplified, but also hitherto unattainable yields and economies have been achieved.

THE NEON ANALYZER-CONTROLLER

The composition of air and properties of its components are shown in Table I. Nitrogen, helium, and neon are the important elements in this particular problem. Nitrogen, boiling at −196°C, makes up 78 per cent of the air. Neon, boiling at −246°C, is present to the extent of 0.0015 per cent. Helium constitutes about 0.0005 per cent and has a boiling point of −269°C.

Fig. 1 is a schematic diagram of the portion of the oxygen column in which neon is produced. Within the vapor space above the trays of a liquid air rectifying column is a small heat exchanger. Liquid nitrogen reflux enters the top of the column and flows downward over the trays of the column. The gas that rises from the trays is cooled to the temperature of the liquid nitrogen and in turn cools the small heat exchanger before being withdrawn as product nitrogen.

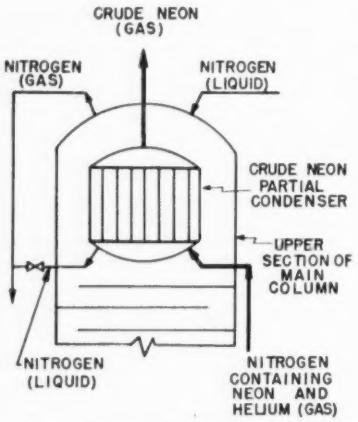

Fig. 1: Schematic Diagram of Crude Neon Recovery Section of Column.

Inside of the heat exchanger nitrogen is condensed and the enriched crude neon is withdrawn overhead. It is possible for nitrogen to be condensed within the heat exchanger by gaseous nitrogen outside of the exchanger because the gas inside is at a higher pressure than the gas outside.

Neon and helium, being more volatile than any of the other atmospheric gases, accumulate within the heat exchanger at the top of the column. These non-condensable gases are withdrawn slowly enough to allow most of the nitrogen in the mixture to be condensed and diverted to the nitrogen product stream, but rapidly enough to assure complete removal of neon and helium.

Production of Neon

Crude neon recovery has been studied extensively during the past quarter of a century. It has been found that practically all of the neon and helium present in the air which is fed to the system is separated in the neon recovery section as shown in Fig. 1. The composition of the crude neon under desirable operating conditions has been found to be about 30 per cent neon, 10 per cent helium, and 60 per cent nitrogen.

In the recovery of neon it is important to withdraw gas at a rate that will result in the highest neon concen-

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TABLE I
COMPOSITION OF AIR AND PROPERTIES OF ITS COMPONENTS

Constituent	Volume, Per Cent	Boiling Point, °C	Thermal Conductivity Cal./sec-cc-°C $\times 10^6$
Air	100.00	—191.5	56.6
Nitrogen	78.03	—195.8	58.0
Oxygen	20.99	—183.0	58.39
Argon	0.932	—185.9	38.2
Neon	0.0015	—246.1	111.2
Helium	0.0005	—268.9	339.0
Krypton	0.00011	—153.2	21.2
Xenon	0.000009	—108.1	12.4

tration consistent with good column performance. Too high a withdrawal rate dilutes the neon with nitrogen, resulting in high handling and purification costs. Too low a withdrawal rate causes the non-condensable portion of the gas to accumulate, upsetting the heat balance over the column. Therefore, it became of interest to develop a control instrument that would be based on gas composition.

Application of Thermal Conductivity Measurement

With gas composition selected as the process variable upon which to base control of the process, it was not difficult to decide which property of the gases to measure. The thermal conductivities of nitrogen, neon and helium are 58.0, 111.2, and 339.0 Cal. per sec. — cc — °C × 10^6, respectively.

Since neon and helium collected in the neon recovery section of the column have been found to have a constant ratio of about three to one, irrespective of nitrogen content, the mixture of neon and helium can be considered a single component having an unvarying thermal conductivity value. It was predicted that this mixture would be easy to analyze using a thermal conductivity cell, and because of previous experience in building thermal conductivity gas analysis indicators, design was undertaken on this basis.

Design of the Control Circuit

The electrical circuit of the thermal conductivity cell is shown in Fig. 2. Four temperature sensitive wire filaments are arranged in a Wheatstone bridge circuit. Two of the filaments are suspended in a confined gas, air in this instance, and the other two filaments are exposed to the gas being analyzed. A constant direct current

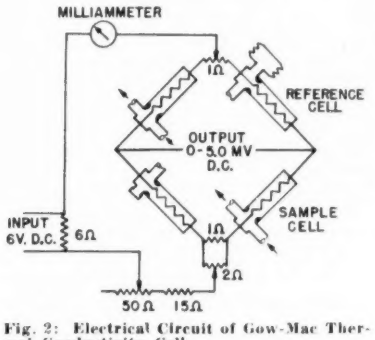


Fig. 2: Electrical Circuit of Gow-Mac Thermal Conductivity Cell.

input is applied to the bridge, causing the filaments to heat up and establishing a voltage drop across the circuit.

All of the filaments are cooled according to the thermal conductivity of the gases in which they are suspended. Resistances of the two filaments in the reference cell remain constant, but the resistance of the filaments in the sample cell changes with temperature, producing a bridge unbalance that can be measured in terms of gas composition.

A six-ohm resistor is placed across the electronic power supply to improve input regulation. Operating current is attained by adjusting the 50-ohm rheostat to produce the desired milliammeter reading. Pontentiometers on the bridge input apexes permit initial balancing of the circuit while a gas of known composition is flowing through the sample cell.

Factors in Cell Application

To make thermal conductivity cells function properly, several inherent peculiarities must be overcome. Changes in temperature cause the thermal conductivity of gases to change. When the two gases in a mixture have thermal conductivities that are nearly the same, it is necessary to house the cell in a thermostatic enclosure. Because of the great spread in conductivities of the system being controlled, no provision need be made for temperature control.

Convection rate within the cell changes with ambient temperature, giving a cooling effect not related to thermal conductivity. Here the use of a reference gas compensates the convection effect of the sample gas.

Water vapor has a high thermal conductivity, which would make either the reference or sample gas seem to contain more neon and helium. In this installation the sample gas, coming from a very cold column, is almost completely dry. A small amount of dessicant (anhydrous calcium sulfate) placed in the reference cell keeps the reference gas dry as well.

Increasing the temperature of a confined gas also raises its pressure. A small brass bellows is used for sealing the reference cell to maintain a constant pressure. Pressure variation in the sample cells presents no problem because the gas is discharged into a gas holder at constant back pressure.

Choice of Equipment

Changes in the gas flow rate over the filaments in the cell were known to cause marked errors in the analysis. For this reason a Gow-Mac cell was selected. The Gow-Mac cell is so designed that the gas is not routed past the filaments, but instead is passed under the chamber containing the filaments. Diffusion of the gas into the sample minimizes the flow effect.

Small variations in supply voltage to the cell circuit would result in considerable variations in output signals. The Sorensen Nobotron used in this installation controls supply voltage closely enough to eliminate supply voltage errors.

Fig. 3 shows the installation in schematic form. Power is supplied to the thermal conductivity cell by a Sorensen Model E-6-5 Nobotron, rated five amperes at six volts d-c.

The heart of the controller is a Gow-Mac Model MT8 double pass thermal conductivity cell, having a current rating of 138 milliamperes at 4.3 volts. Measurement of cell output is accomplished by a Foxboro Dynalog Recording Stabilog voltage controller, having a range of 140 millivolts. The control unit is a Model 40 pneumatic-operated controller, with a 0-200 per cent adjustable proportional band, automatic reset, and derivative action.

The control valve is a Hammel-Dahl diaphragm-operated spline plug valve with a Foxboro Valvactor attached, arranged to open on increasing neon content of the product gas.

Recommended sampling rate for a Gow-Mac cell is one cubic foot per hour. To improve response of the instrument to process conditions, the gas is sampled through ⅛-inch copper

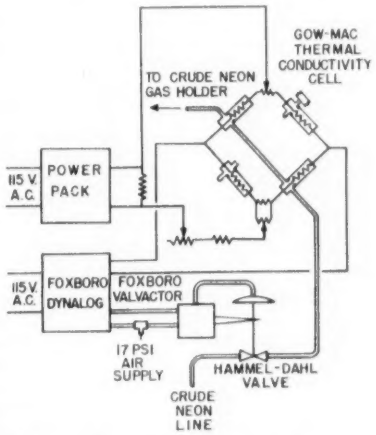


Fig. 3: Schematic Diagram of Neon Attachment Controller.

tubing. Although the cell is designed for diffusion of sample gas from the gas stream to the filaments, response is very rapid. Changes at the column begin to appear at the recorder within half a minute, and 90 per cent response occurs in less than two minutes.

Control Results Obtained

Derivative action of the Dynalog controller has been especially valuable in this application, bringing about recovery from upsets in approximately 10 minutes as compared to 20 minutes when derivative action is not used. The reason for this seems to be that composition of the crude neon depends almost entirely on the rate of purging, and not so much on conditions beyond the control of the Hammel-Dahl valve.

A common complaint with thermal conductivity analyzers is the tendency to "drift". This is believed to be caused by leakage of the reference gas and replacement with air. In place of a reference gas comprising a mixture similar to that being analyzed, as is commonly used, air has been sealed in the reference cell. To date no drifting has been reported. Since the analyzer-controller was placed in operation, crude neon has been consistently high in neon content, and no accumulation

of non-condensable gases in the recovery apparatus has been observed.

Fig. 4 is a front view of the neon analyzer-controller installed in a cubicle. At the top is the Foxboro Dynalog controller. Below it are the milliammeter, cell current rheostat, and cell balancing potentiometer. Near the center of the cubicle is the sample flow indicator. At the bottom is the Sorensen Nobotron power pack.

Fig. 5 is a rear view of the same cubicle, showing also the thermal conductivity cell enclosure and the control valve air filter and regulator. Fig. 6 shows the Hammel-Dahl valve and valve positioner used to regulate crude neon flow.

THE OXYGEN AND ARGON ANALYZER CONTROLLERS

An oxygen rectifying column was also equipped for automatic control of product purity. Not only was it necessary to control oxygen product purity between 99.55 and 99.65 per cent, but it was also required that the argon by-product be kept above 95 per cent purity. At the same time no more than 0.15 per cent oxygen could be tolerated in the nitrogen product.

Production of Oxygen, Nitrogen, and Argon

To produce oxygen, nitrogen, and argon from air, liquid air, enriched in oxygen by "flashing" into a separate section of the column, is fed to the middle of the rectifying column, shown in Fig. 7. Nitrogen, being the more volatile, is enriched toward the top of the column, while oxygen becomes purer as it proceeds downward. Argon is only slightly more volatile than oxygen and tends to follow the oxygen down the column.

An argon rich sidestream containing oxygen and a trace of nitrogen is taken off the main column and is rectified in an auxiliary column, shown in Fig. 8, returning oxygen to the stream from the lower section of the main column.

The sidestream column is a complete rectifying column in itself, having a reboiler, separating trays, and partial condenser. Nitrogen gas at a pressure of 65 psig supplies heat to the reboiler, and at this pressure the nitrogen is condensed. Expansion of the same nitrogen to atmospheric pressure cools it enough to act as the refrigerant in the partial condenser.

In manual operation of the column the oxygen product valve is opened to decrease purity and is throttled to increase purity. If oxygen content falls below 99.50 per cent, the product is not acceptable. If the purity rises to 99.70 per cent, production rate is diminished and purity of the nitrogen product falls below 99.85 per cent. Oxygen is analyzed periodically with apparatus of the Orsat type.

Nitrogen purity determined by catalytic combustion of contained oxygen with added hydrogen is recorded continuously. The analysis of argon using a gas density balance is tedious and is subject to considerable errors. A well-trained operator can regulate product quality and take care of all of the other process variables, but constant attention is required. It is virtually impossible for the operator to produce at the same time a continuous stream of 95 per cent argon from the sidestream column.

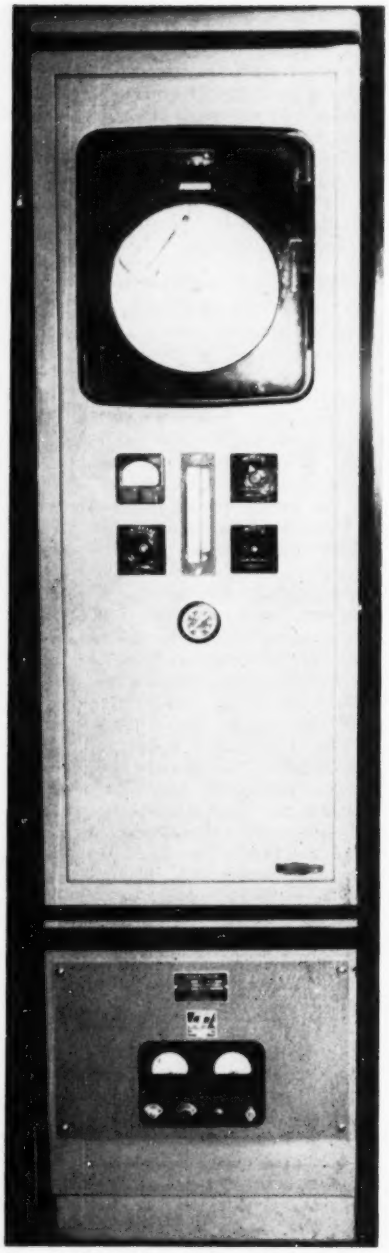


Fig. 4: Front View of Neon Analyzer-Controller Cubicle.

Design of the Control System

In the design of automatic controllers for the oxygen and argon columns, all process variables were considered. Temperature control was out of the question because an immeasurable temperature difference represented a large change in composition. Here also the control system was designed around a thermal conductivity cell.

Two controllers were built, one for oxygen control; the other for control of crude argon purity. The arrangement is shown schematically in Fig. 9.

A Sorensen Model E-6-5 Nobotron serves as the power supply for both units. Each has a Gow-Mac Model MT thermal conductivity cell, rated 200 milliamperes at 1.2 volts. The Foxboro Dynalogs on both units have a range of 0-5 millivolts, with 200 per cent proportional band, automatic reset, and derivative action. A Foxboro two-inch diaphragm-operated valve with Vernier Valvactor, arranged to open with increasing oxygen content, is installed in the oxygen product line to maintain oxygen purity.

Here again the problem of analyzing a three-component mixture arises. The three components are nitrogen, oxygen, and argon. Nitrogen and oxygen have thermal conductivities that are nearly the same when compared with that of argon. Control sample is therefore withdrawn from the lower trays of the main column and is analyzed for argon. Because argon and oxygen content vary in a nearly linear ratio under the desired control conditions, the analysis for argon can be translated in terms of oxygen content.

The reference cell contains air and dessicant, and is sealed with a brass bellows. Proportional band is set at 100 per cent and reset is at 2.0 minutes. Because of irrelevent disturbances, derivative action seems to be of little or no value. Upsets are remedied, however, in less than 20 minutes. Control upsets ordinarily great enough to cause an operator serious trouble are remedied without recourse to manual control. Control upsets occur when the plant air driers are changed, or when liquid is withdrawn from the column.

Control of Argon Purity

Control of argon purity was first attempted by passing product argon through the analyzer. The trace of nitrogen present at the base of the sidestream column becomes a major impurity by the time the mixture reaches the top of the column. Nitrogen collects rapidly when the argon valve is throttled. Because nitrogen and oxygen have nearly the same thermal conductivity, oxygen content must be diminished quickly, or nitrogen will accumulate and cause the valve to close completely. No practical setting of the control point would hold control.

Reversing the valve action so that the controller acted as a nitrogen purger rather than a reflux controller resulted in some improvement in performance. Yields were poor, however, and nitrogen content was too high.

Excellent control was attained by sampling at the inlet to the sidestream column where nitrogen did not accumulate. Purity was thereafter easily con-

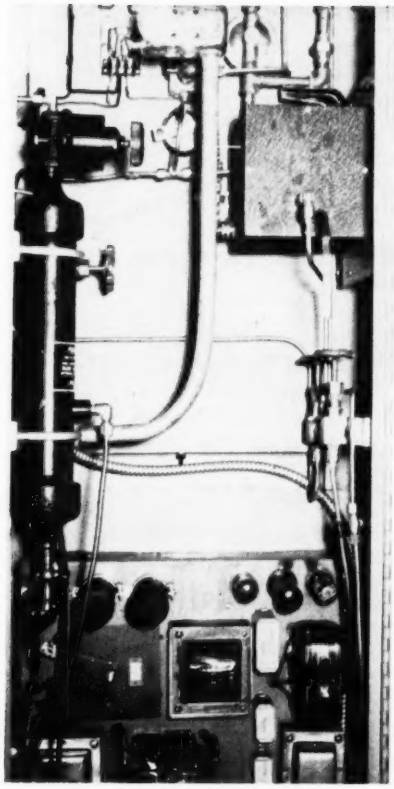


Fig. 5: Rear View of Neon Analyzer-Controller Cubicle.

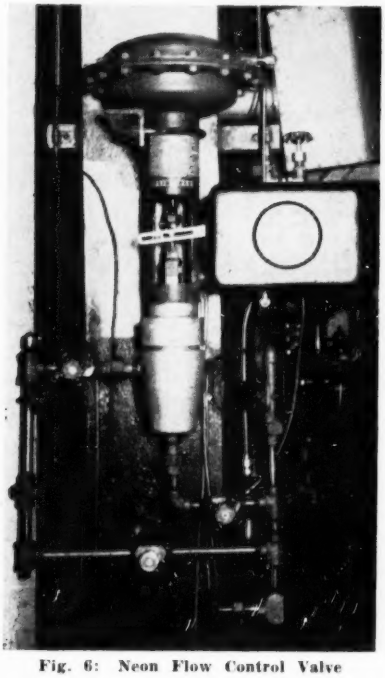


Fig. 6: Neon Flow Control Valve

trolled above 95 per cent argon and total crude argon production exceeded that realized by manual operation.

Proportional band was set at 200 per cent, reset was adjusted to 5 minutes, and the Dynalog range was increased to 15 millivolts to overcome excessive sensitivity of the controller. Derivative action was not used, but control upsets were remedied in less than 20 minutes.

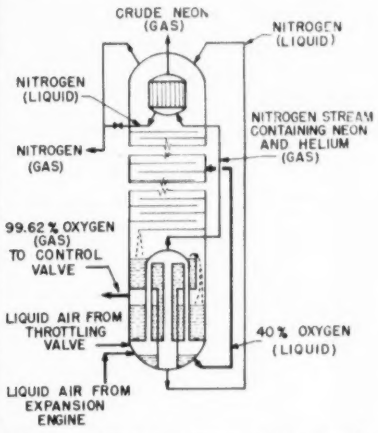

CRUDE NEON (GAS)
NITROGEN (LIQUID)
NITROGEN (LIQUID)
NITROGEN STREAM CONTAINING NEON AND HELIUM (GAS)
NITROGEN (GAS)
99.62 % OXYGEN (GAS) TO CONTROL VALVE
LIQUID AIR FROM THROTTLING VALVE
40 % OXYGEN (LIQUID)
LIQUID AIR FROM EXPANSION ENGINE

Fig. 7: Schematic Diagram of Air Rectification Apparatus.

OTHER APPLICATIONS OF AUTOMATIC GAS ANALYSIS

Thermal conductivity cells are widely used to indicate and record purity of helium, composition of helium-neon mixtures, of hydrogen-nitrogen mixtures and of carbon dioxide content of flue gases.

In the purification of argon, hydrogen added to crude argon combines with the oxygen impurity in a catalytic reactor. A Leeds and Northrup thermal conductivity cell analyzes the deoxygenated gas for hydrogen and operates a diaphragm motor valve to regulate the addition of hydrogen.

Consideration has been given to the use of a Beckman paramagnetic oxygen analyzer for the same purpose, adding hydrogen according to the oxygen content of the crude argon.

Catalytic combustion analyzers are now being used as indicators and recorders in the production of high purity nitrogen and argon. To analyze for hydrogen, a slight excess of hydrogen-free oxygen is added to the sample and the mixture is passed through a

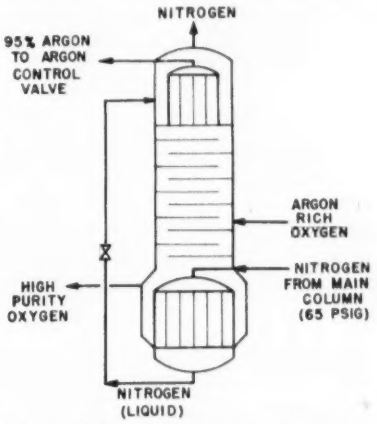


Fig. 8: Schematic Diagram of Argon Recovery Apparatus.

bed of catalyst. The temperature rise is measured with a thermopile and is recorded or indicated in terms of hydrogen content.

Oxygen is likewise detected by addition of hydrogen, followed by catalytic combustion. Although none of these catalytic combustion analyzers are being used as controllers, a few are equipped with upper limit contacts to operate alarm signals and shut-off valves.

Air Reduction Research Laboratories are continuing development of gas analysis controllers wherever standard instruments are not available for specific application to its control problems. Improvements are constantly being made on thermal conductivity and catalytic combustion analyzers.

Acknowledgement

The authors wish to express their appreciation to the Air Reduction Co., Inc. for permission to present this article.

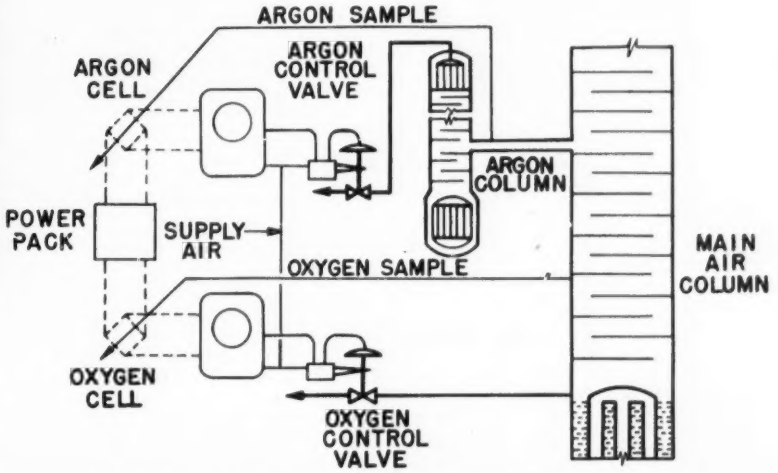
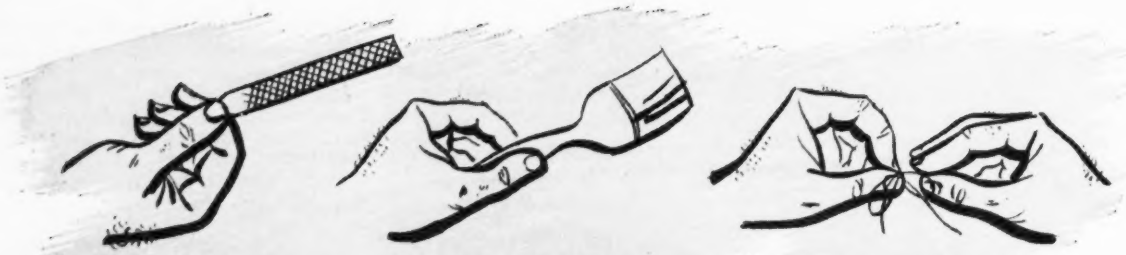


Fig. 9: Schematic Diagram of Oxygen and Argon Purity Controllers.



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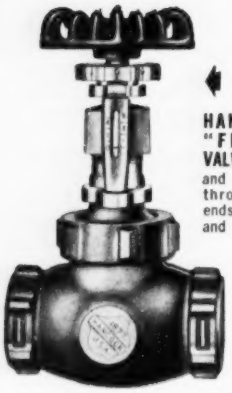

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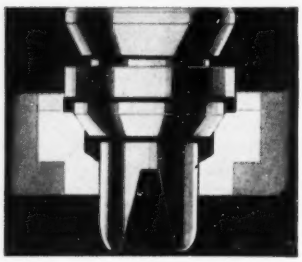

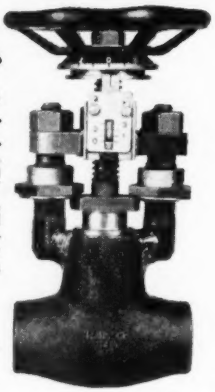

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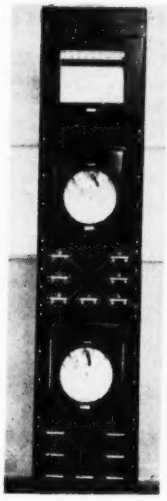
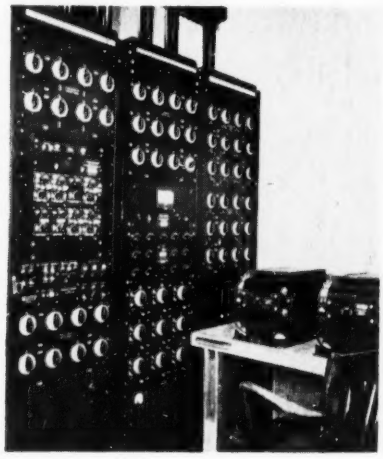
Instrumentation for Rocket Testing

Instrumentation techniques applicable to testing of rocket engines are presented, with emphasis on temperature, pressure, force, thrust, weight, propellant consumption, and accuracies. The influence of industrial-instrumentation technique is emphasized.

by
EDWARD CARTOTTO
North American Aviation, Inc.



← Fig. 1. Typical instrument rack assembly.



← Fig. 2. Oscillograph station.

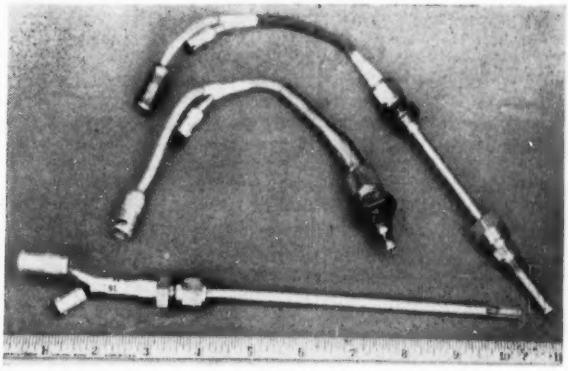


Fig. 3. Tri-axial thermocouple & terminal assembly.

AS new fields of endeavor develop, instrumentation to meet new requirements is of two kinds—(1) borrowing apparatus and technique from an established field and adapting it to the new requirements, and (2) conceiving new techniques and developing apparatus for their implementation. This article describes rocket-testing instrumentation of the first kind, particularly as adapted from industrial instrumentation technique. The required deviations from industrial practice seldom alter the basic instrument, but they may require modifications in chart speed, pen speed, and sensitivity.

Rockets tests are often of short duration, seldom exceeding 60 seconds and frequently as short as 1 or 2 seconds. As the tests are costly, it is desirable to take as many simultaneous measurements as the design of the test station permits. It is not unusual to take as many as 60 or 65 measurements in the test of a complicated assembly. In addition, up to 40 variables may be recorded. Single-pen direct-inking continuous-balance instruments are used most often, although multipoint printing pyrometers are occasionally useful. Several variables are recorded on multipoint operations sequence recorders. One or more multichannel photo-recording oscillographs are required for making dynamic measurements.

A typical instrument rack assembly is shown in Fig. 1; many such racks are used in a rocket test station. Note the accessory panel below the recorders; this panel contains a circuit-selector switch, several circuit-matching elements, and a chart-drive switch. These accessories provide flexibility in test-station operation and make possible rapid switching of the recorder to any one of several test pits served by the recorder. The circuit-matching elements permit the adjusting of system sensitivity over a wide range so that one recorder, when used with numerous transducers, can be calibrated to a variety of ranges without altering internal adjustments. Similar flexibility of range and circuitry is available at the oscillograph station (Fig. 2).

Temperature Measurement

Of the measurements made in rocket testing, temperature measurements show the smallest deviation from industrial techniques. The thermoelectric pyrometer recorder finds many uses in the test station. Multipoint printing pyrometers are used in tests of long duration and also during the preparation periods before tests. Temperatures of propellants or of components subjected to low temperatures are recorded. Seldom are all points connected to dif-

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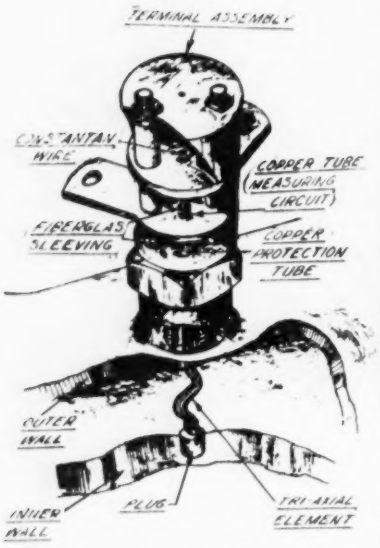


Fig. 4. Exposed-junction thermocouples.

ferent thermocouples, because the time required to complete a full printing cycle may become an appreciable part of the total test time.

Generally, temperatures are measured by single-pen recorders, and range in values from minus 300 to plus 2000 deg. F. These recorders are of the round-chart variety with chart speeds of one revolution or one-fourth revolution per minute. Pen speeds are such that pens traverse the full chart span in one second or less. The Foxboro "Dynalog" EMF recorder is used to good advantage because its range can be altered by changing plug-in range elements.

Conventional thermocouple alloys are used, although combinations such as tungsten-molybdenum are used in special research projects. Thermocouple configurations are not conventional. Odd designs are required because a thermocouple for rocket-test work sometimes must have several of the following characteristics: (1) it should be small in size so its presence will not affect the process whose temperature is being measured, (2) it should have a short response time, (3) it should be serviceable at pressures of 2000 psi. and temperatures up to 2000 F., (4) it should be capable of installation without appreciably weakening a component, and (5) it should not be subject to errors resulting from spurious thermoelectric effects when embedded in metals.

An interesting application of pyrometry in testing a rocket motor is measurement of wall temperature. Thirty or forty thermocouples must be embedded in the inner wall with their leads passing through the coolant jacket and connected to pressure-tight terminals on the outer wall. All leads must work through a small-diameter hole in the outer wall. The thermocouple installation in Fig. 3 illustrates the

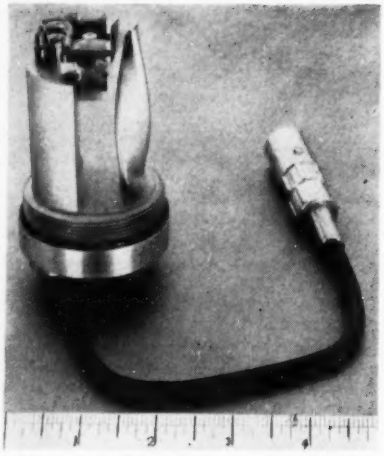


Fig. 5. Variable-reluctance pressure pickup.

difficulties encountered. This thermocouple consists of a constantan wire insulated with a fiberglas sleeving over which is drawn a thin copper tube. A protection tube for this assembly is made by insulating the copper tube with a fiberglas sleeving and drawing a second copper tube over the entire assembly. When completed, the outer diameter of this tri-axial assembly is about 0.060 inch.

To one end of the tri-axial assembly is affixed a plug made of the same material as the motor wall. The measuring junction is formed by flowing silver solder into the slightly concave surface of the plug. Machining the soldered end to a shallow conical form completes the thermocouple. Installation into the motor wall is made by peening the plug into a hole. This hole must be prepared carefully because the plug must fit snugly and must bottom properly to provide good contact.

Thermocouples for measuring fluid temperatures are almost always made with exposed junctions (Fig. 4). This is necessary to get a short response time. As a complete protection tube is not used, sealing against pressures of 2000 psi. and greater is a problem. A suitable seal is made by using porcelain cement backed up with a synthetic resin cement. The porcelain cement withstands high temperatures but, because of its porous nature, is not an effective pressure seal. The synthetic resin cement, conversely, is an excellent sealant but incapable of withstanding high temperatures.

Fig. 7. Force pickups.

Pressure Measurement

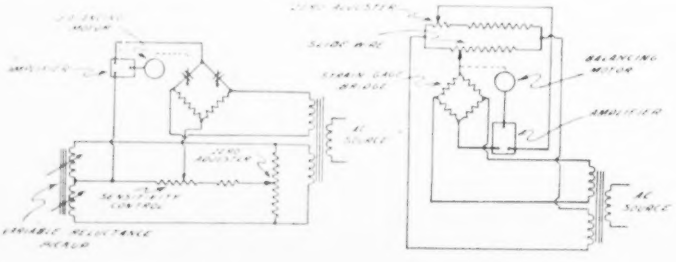
In a rocket test, there are generally as many measurements of pressure as of all other variables combined. Pressures are measured in the propellant tanks, in the steam-generating system, in the pumps and turbines, in the compressed-air control system, and in the combustion chamber. Differential-pressure measurements are made across fuel and oxidizer injectors, cooling jackets, and orifice plates when flow-rate measurements are desired.

Owing to the hazards involved in testing rockets, all measurements are made from remote locations and the magnitude of the variable is telemetered electrically to a recorder. Electrical telemetering is necesary because of the high rate of change of the variable, even when steady-state conditions are expected. It is not unusual to record (on direct-inking recorders) pressures that pulsate at rates of four or five cycles per second.

Many types of transducers are available for pressure measurements. In rocket testing the resistance strain gage and the variable-reluctance gage are popular because they are small, rugged, and reliable. Each has some advantage over the other but they are about equally useful. As the strain gage can be energized with d.c., it permits a simpler setup than the variable reluctance gage, especially when the measurement need not be recorded. Strain gages usually are used in conventional a-c. or d-c. Wheatstone-bridge circuits.

The variable-reluctance gage (Fig. 5) must be energized with a.c. because it depends on change in coil impedance. In this pickup the torsional bourdon

Fig. 6. Connection of pressure pickups to recorders.



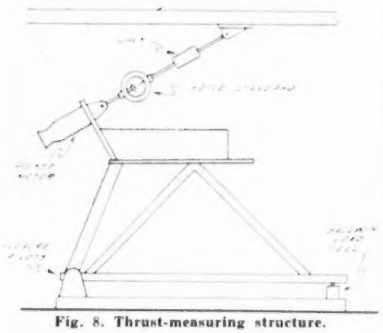


Fig. 8. Thrust-measuring structure.

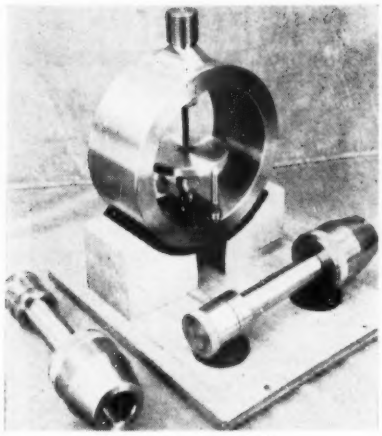


Fig. 9. Force standard.

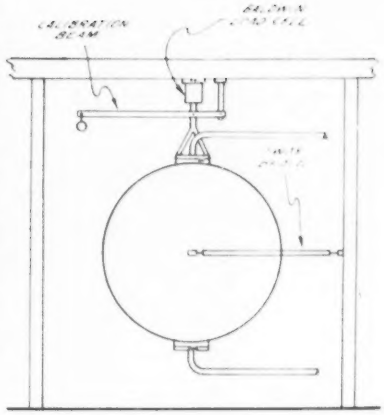


Fig. 10. Continuous-weighing tank system.

tube actuates an armature whose position influences the impedance of the coils, which are two legs in a Wheatstone-type reactance bridge. All strain-gage and variable-reluctance-gage installations are not simple. When amplifiers are required, or when pressure pulsations of several hundred cycles per second are under investigation, the circuit complexity increases.

Steady-state measurements of pressure or slowly varying pressures are recorded on graphic instruments like the Leeds & Northrup "Speedomax," the Brown "Electronik," or the Foxboro "Dynalog" recorder. Fig. 6 shows simplified schematic diagrams of a strain-gage pressure pickup connected to a recorder using a slide wire for balancing, and a variable-reluctance pressure pickup connected to a recorder using a variable capacitor for balancing. Both circuits are equally capable of excellent performance. Response of the systems to pressure variations is limited by the inertia of the balancing system; when the amplitude of pulsations is about 5 percent of full-scale range, each system can record variations of 4 or 5 cycles per second.

The recorders used for pressure measurement are similar to the bridge recorder used in pyrometry. With the d-c. strain-gage bridge, a conventional EMF recorder can be used if its automatic reference-junction compensator is disconnected. The circuits of Fig. 6 are used for either gage-pressure or differential-pressure measurements.

Force Measurement

Appropriate configurations of elastic systems can be used in conjunction with resistance strain gages or variable-reluctance strain gages for measuring force or weight. Typical force pickups are shown in Fig. 7. The Baldwin load cell and beam are strain-gage devices; the force ring is a variable-reluctance device. Electrically there is no difference between these force-measuring devices and the pressure pickups discussed previously; the schematic diagrams for their electrical connections are identical to those of Fig. 6.

Even in the simplest rocket test it is usually necessary to measure the thrust developed and the weight of propellants consumed. Any one of the many force pickups available can be used provided they are correctly installed in the test structure. Fig. 8 shows one thrust-measuring structure suitable for testing rocket motors. The force pickup is operated in compression and measures the component of thrust transmitted by the structure as it tends to turn on the flexure pivots. This measurement can be recorded on a "Dynalog" cell-type recorder or on any other recorder capable of receiving an a-c. input signal. In installation of this type it frequently is impossible to measure accurately the distances and angles that relate the force developed by the rocket motor to that applied to the load cell; consequently some means for calibration must be provided. In Fig. 8, calibration can be performed by attaching the jack and force standard between the tie points provided on the thrust structure and the overhead beam. Forces developed by the jack are applied on the axis of the rocket motor. In this way, without knowing the actual load applied to the force pickup, the thrust-measuring system can be calibrated. The force standard, a Morehouse proving ring (Fig. 9), is accurate to plus and minus 1/10 percent when certified by the Bureau of Standards.

A structure designed to use standard weights for calibration of a tank-weighing system is shown in Fig. 10. This suspended tank system is used for recording the weight of a propellant in the tank. As the weight is recorded continuously, the flow rate can be determined from the slope of the recorded curve. This system is calibrated by hanging standard weights on the end of the calibrating beam.

Weights can be recorded remotely also by combining a beam scale and a recorder, as in the Kron-Brown scale system. The tank is suspended from the scale and its weight indicated on the scale dial. The weight can be transmitted to the recorder by a differential inductance transmitter located in the scale head. A core, which is supported axially in the inductance, changes position as the weight of propellant in the tank changes. The resulting changes of inductance unbalance the bridge circuit of a self-balancing recorder.

Two other ways to measure propellant consumption are used in industry in similar manner. One is the use of a differential-pressure measuring system for measuring head on a tank of known dimensions; the other is the use of head-type meters. The only deviation from an industrial installation is in the use of electrical transmitters capable of transmitting rapid changes.

Accuracies

As data derived from tests conducted in many different test pits must be compared and used in calculations, accuracies required are high. It is not enough to have good repeatability; accuracies must be established on an absolute basis. In general, limits of errors are smaller than plus and minus 1 percent of range. To establish and maintain these accuracies, it is necessary to have standards of high accuracy and precision, and to calibrate often and with care. It is not unusual to find several measuring systems being calibrated immediately before and then after a test.

The influence of industrial instrumentation in this new field has been strong. Few instrument manufacturers produce instruments for the rocket industry alone. Consequently, as new test requirements arise, the rocket station continues to look to industrial instrumentation for suitable techniques and usable apparatus.

Bibliography

(1) Troke, Robert W. "The Direct-Reading D. C. Strain-Gage Bridge." *Instruments*, April and May 1951.

(2) Pressure and Force Transducers. Minneapolis-Honeywell Data Sheet No. 10.18-1.

(3) Sutton, George P. "Gaging Rocket Engine Forces and Flows." *Aviation*, April 1947.

(4) Sutton, George P. *Rocket Propulsion Elements*, Published by Wiley & Sons.

(5) Hylkema, Chester G. "A Central Recording System." Paper delivered to ISA, September, 1949.

(6) Abbott, W. F. "Adaptation of Industrial Instrumentation to Static Testing of Liquid Propellant Rockets." Paper delivered to ISA, September, 1949.

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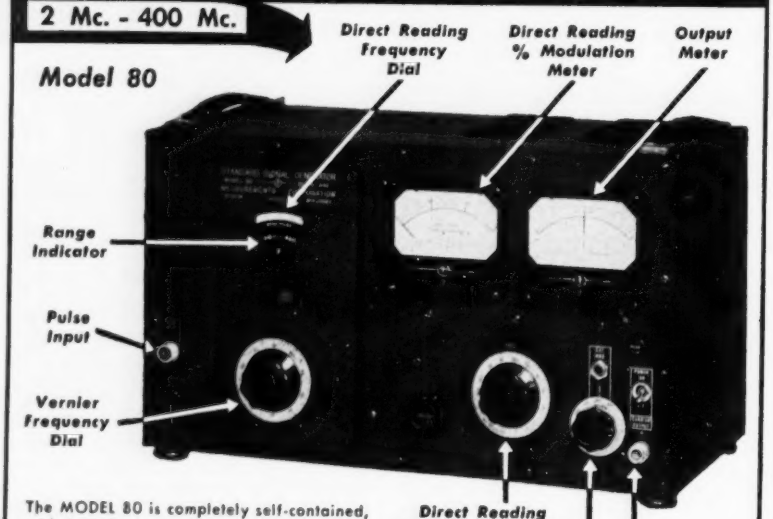

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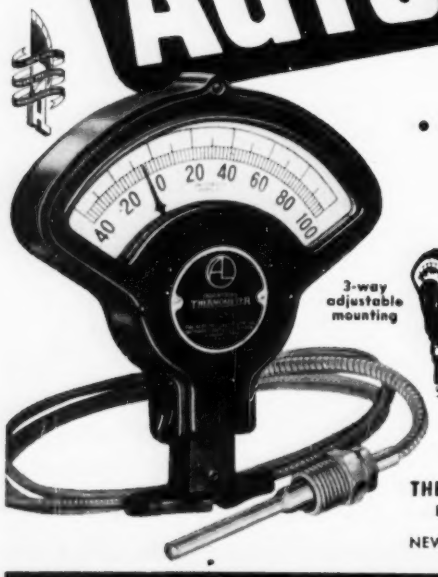

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May 11-13
IRE National Conference on Airborne Electronics, Dayton, Ohio.

May 14
Civil Engineering Dept. of Manhattan College conference on Instrumentation in water, sewage and industrial waste treatment, Manhattan College, N. Y. For information write Dept. of Civil Engineering, Manhattan College, New York 71, N. Y.

May 17-28
Fourth Gauge and Tool Exhibition, New Hall, London. For information write Gilbert Beach, Sec., Standbrook House, Old Bond St., London, W.1, England.

May 18-21
1953 Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

May 19-23
Instrument Exhibit Societe Francaise de Physique, Sorbonne, Paris, France.

May 20-22
Spring meeting of SESA, Hotel Schroeder, Milwaukee, Wisconsin. For information write W. F. Hofmeister, Metallurgical Lab., Chain Belt Co., 4501 W. Greenfield Ave., Milwaukee, Wis.

May 20-22
First National Telemetering Conference, Edgewater Beach Hotel, Chicago, Ill., sponsored by Institute of Aeronautical Sciences, Institute of Radio Engineers, and Instrument Society of America.

May 24-28
Scientific Apparatus Makers Association, Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va.

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June 15-20, 22-25
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July 20-31
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July 27-31
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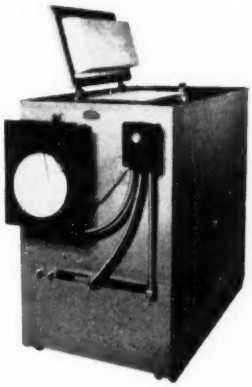

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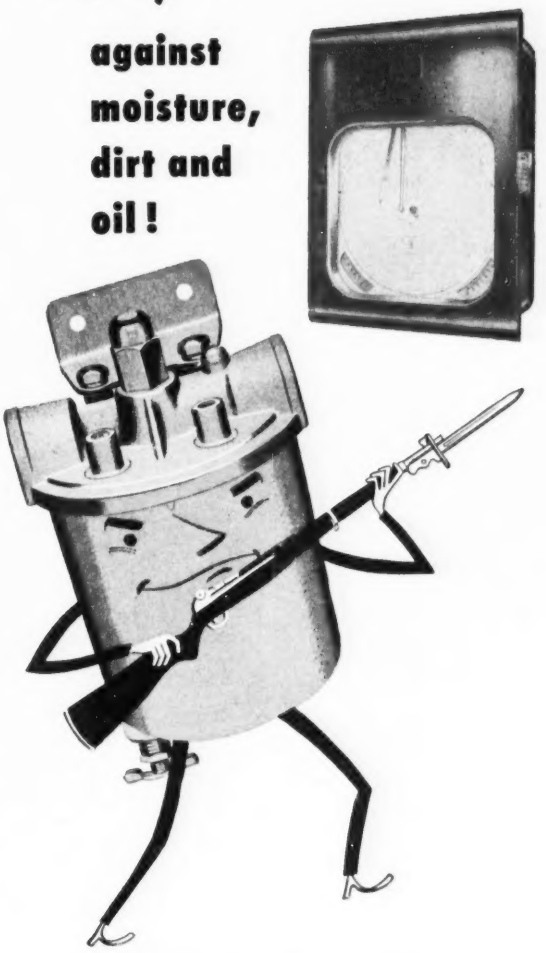

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Air Pollution

Continued from page 568

(Whatman No. 4), which is supplied as tape from a spool. The upper motor makes one revolution each six hours and, at the proper time, operates a microswitch which energizes a solenoid and the windup motor, thus shifting the position of filter paper tape in preparation for the next sample. The sample-time frequency, however, is readily increased by addition of spindles to the timing rotor.

A quiet, low-cost air pump suitable for this apparatus could not be found among commercially available units; we designed the simple low-speed bellows pump attached to the rear of the panel. The total assembly is being made available for $125.

Fig. 9. shows a record obtained by this instrument, and a typical variation in smoke intensity—relatively high intensity at night and low intensity during sunlight hours.

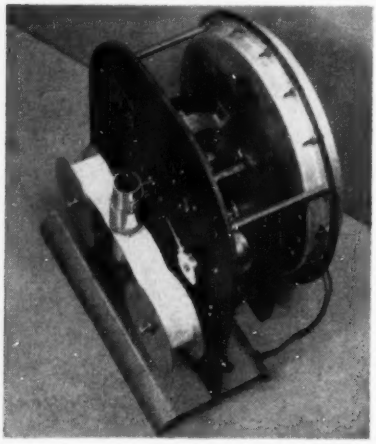

Fig. 8. A.I.S.I. automatic smoke filter sampler.

Simple modifications in timing make this unit available for stack smoke sampling, as previously indicated. A similar smoke sampler has been designed by the Chaney Laboratory[2].

Sampling for Coarse Dust

A determination of the concentration of coarse particles at ground level could be made by aspirating samples of air in measured rate through a filter or electric air cleaner, although this is not commonly done. Any weight concentration, however obtained, must inevitably exclude the fine particles. Particles larger than two to four microns are not inhaled into the deep lung and, therefore, a weight measurement of air-suspended solids would not determine the amounts of air-suspended particulate matter that would be inhaled. Such a measurement would, however, provide a good index of the quantities of *coarse* material that are raining out by gravity at the time of the test.

Dust-fall Measurements

The weight concentration method is laborious in comparison with the direct measurement of dust fall as determined by exposure of open-top vessels wherein, after a suitable exposure period, the accumulated material is weighed. This is a faithful index of the major nuisance value of coarse particles. This measurement, carried out routinely by a large number of cities, has been subjected to considerable criticism, partly because of failure to distinguish between coarse and fine particles and partly because of the difficulty in locating a single exposed jar in such a way as to have it truly reflect the average dust fall for the entire neighborhood surrounding it. We have been studying the variation in deposits in jars within the Oakland neighborhood and find variations of 200 to 400 percent between gauges on the top of Mellon Institute and others exposed at various levels on the nearby Cathedral of Learning. These studies are continuing.

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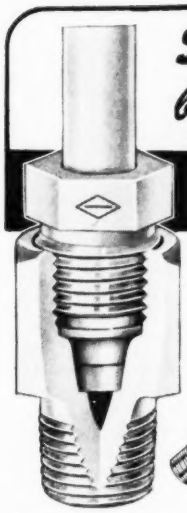

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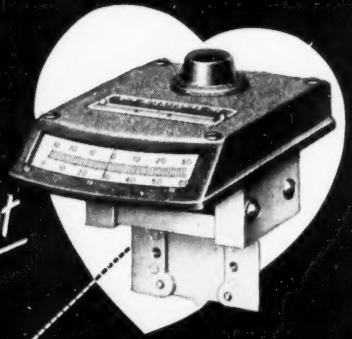

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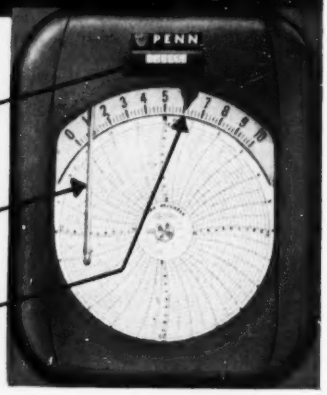

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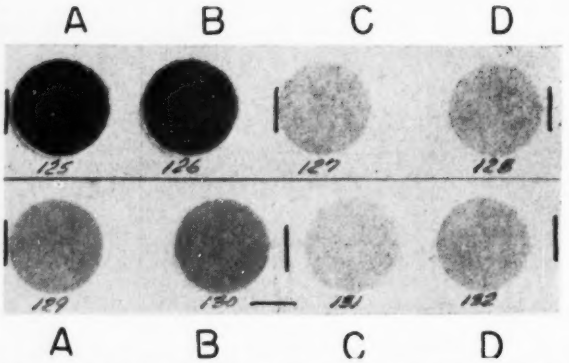

Fig. 9. Smoke filter record for July 29 and 30, 1950. A, early morning (11 PM-5 AM); B, late morning (5 AM-11 AM); C, afternoon (11 AM-5 PM); D, evening (5 PM- 11 PM).

sary to obtain a quantity for satisfactory weighing. There is a great need for an instrument analogous to the automatic smoke filter that will indicate coarse particles for short time periods of a few hours.

Gases

The gas of primary interest to steel plants and industry and communities in general is sulfur dioxide. In many industrial areas, including steel-plant towns, hydrogen sulfide is of interest also. In comparison with the sampling problems for particulate matter, there is no corresponding difficulty in the sampling of gases. There are two instruments available for the automatic determination and recording of sulfur dioxide—the Thomas "Autometer" and the "Titrilog."

Thomas "Autometer"

The Thomas SO_2 recorder[3] operates on a simple principle. The air to be sampled is aspirated through the gas absorption unit (hydrogen peroxide and sulfuric acid),

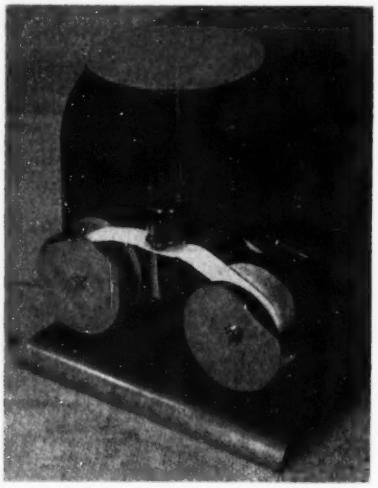

Fig. 10. Automatic H_2S sampler.

whereby sulfur dioxide is dissolved and oxidized to the sulfate ion. The conductivity of the resulting solution is measured and automatically recorded on a chart calibrated in the parts per million of SO_2. Other soluble gases such as HCl, hydrogen sulfide, and ammonia, if present, are included in the results. The instrument can determine concentrations as low as 0.1 ppm. of SO_2.

"Titrilog"

A more recent instrument[4] for the automatic recording of sulfur dioxide concentrations, the "Titrilog," operates on the following principle: Bromine gas reacts by oxidation with sulfur dioxide. Bromine is generated by electrolysis of potassium bromide solution at a rate which varies with the quantity of SO_2 that has been captured in an absorption cell. The electrical rate of bromine electroly-

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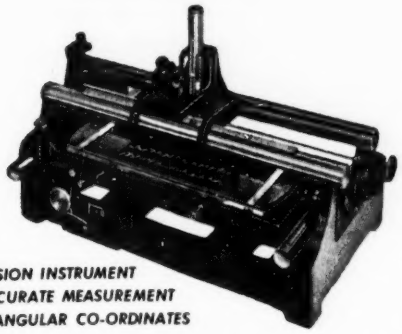

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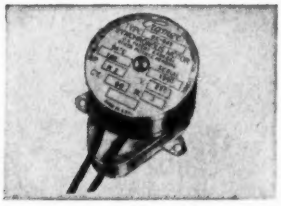

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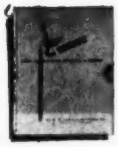

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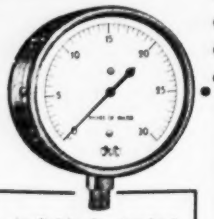

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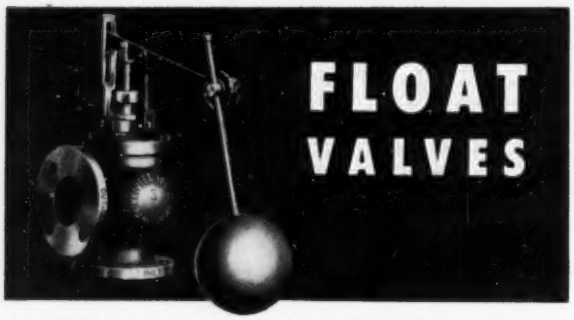

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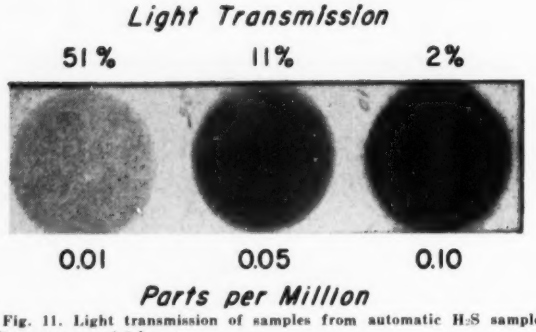


Fig. 11. Light transmission of samples from automatic H_2S sampler after exposure of 6 hours.

sis is automatically recorded on a chart. If other oxidizable compounds are present, such as hydrogen sulfide and certain other organic sulfides, their effect will be added, but they are rarely found in significant concentrations.

The standard unit is capable of measuring SO_2 concentrations as low as 0.1 ppm. but the sensitivity can be increased by instrument modifications to register concentrations as low as 0.02 ppm.

Hydrogen Sulfide

Rubicon Automatic H_2S Recorder

A commercially available instrument for automatic recording of H_2S concentrations, the Rubicon,[5] absorbs hydrogen sulfide in filter paper that has been treated with lead acetate. The blackness of the resulting spot is evaluated by reflection of light from a stained portion of the tape and measurement by a photocell which is automatically compared with the reflectance from a non-exposed portion of the same tape. The results are recorded on a chart calibrated in terms of H_2S concentration. This instrument may be set to give full-scale deflection for any hydrogen-sulfide concentration up to several hundred ppm.; concentrations as low as 0.1 ppm. can be detected.

A.I.S.I. Hydrogen Sulfide Sampler

We are currently completing the development of a hydrogen-sulfide sampler (Fig. 10) based on the absorption of the hydrogen sulfide in filter paper that has been impregnated with lead acetate and glycerine. The resulting spots are evaluated by a measurement of the amount of light transmission (Fig. 11). Evaluation requires manual operation in the laboratory; the instrument is designed for simplicity and low cost and to supplement the automatic recorders. Present indications are that concentrations of 0.05 ppm. of hydrogen sulfide in a one-hour sample will be measurable.

Conclusion

The most important of the facts presented are those concerning the relative properties of fine particles and coarse particles as they are related to the problem of measurement. As city dust and soot is a mixture of large and small particles, any single measurement method includes only one of those two fractions. Discrimination between them serves as a guide to the proper use and sound interpretation of air-pollution measurements.

References

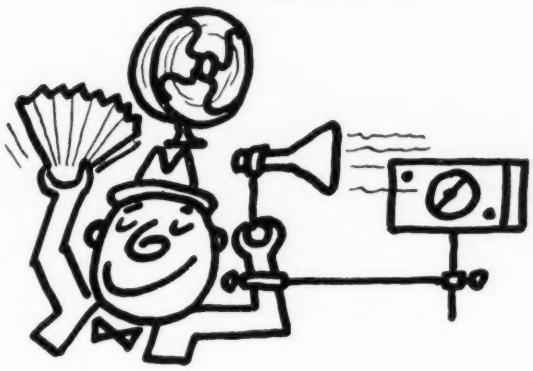
1. Davidson, W. F., "A Study of Atmospheric Pollution." *Monthly Weather Review*, Vol. 70, pp. 225-234, October, 1942.

2. Hall, Stanley R., "Instrumentation for the Recording of Air Pollution Levels, *Proceedings*, Air Pollution & Smoke Prevention Association, p. 124, 1951.

3. Thomas, Ivie, and Fitt, Industrial Engineering Chemistry, Anal. Ed. 18, 383 (1946). Manufactured by Leeds & Northrup Co., Philadelphia, Pa.

4. Washburn, H. W. and Austin, R. R., "Some Instrumentation Problems in the Analysis of the Atmosphere," Proc. First National Air Pollution Symposium, Los Angeles, Calif. (1949). Manufactured by Consolidated Engineering Corporation, Pasadena, California.

5. Manufactured by the Rubicon Company, Philadelphia, Pa.



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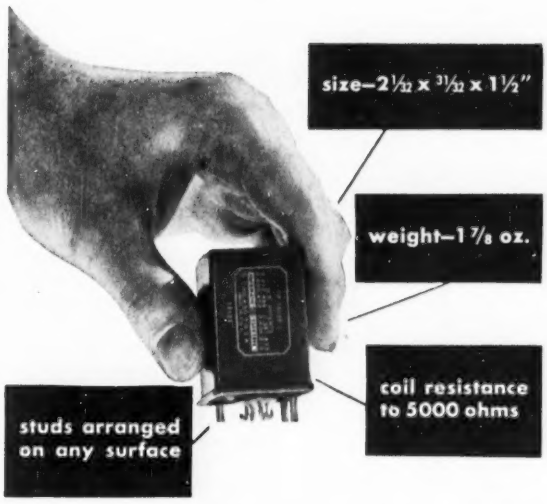

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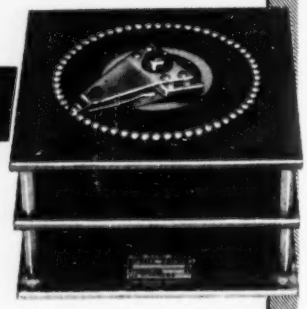

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Water Instrumentation

Continued from page 571

Sludge Digestion and Filtration

Sludge from the primary and secondary tanks in a sewage-treatment plant is commonly digested in separate heated sludge digesters. The pH of the digesting sludge should be controlled and recorded. After the sludge has been digested it is usual to dewater it; in this operation it is desirable to automatically adjust the pH of the conditioned sludge to the optimum level for filtration.

Boiler Feed Water

In a number of steam-generating plants it has been found necessary to carefully adjust the pH of boiler feed water to protect auxiliary boiler equipment from corrosive attack or deposit formation. In plants where condensed feed water is used it is often necessary to raise the pH in order to avoid acid corrosion of the boiler feed pumps. This can be accomplished either by recirculating a small amount of the alkaline boiler water to some point in the system before the feed pump, or by continuous addition of a small amount of an alkaline chemical. In installations where large amounts of lime-soda-ash-treated makeup water are used it often is desirable to feed dilute acid continuously to the makeup water to lower the pH to a point where after-precipitation and deposit buildup in deaerating heaters, stage heaters, feed lines, and economizers will be controlled. Accurate adjustment of pH is mandatory for the latter operation because there is great danger of severe damage to the boilers and auxiliaries if over-feeding should occur.

Industrial Waste Treatment

Adjustment of pH in the treatment of waste containing partially or completely emulsified oil usually is essential. In springing soluble oils, treating chemical requirements can be correlated closely to the alkali content of the original soluble oil composition. Consequently, except where considerable waste acid is available for neutralization of the excess alkali, or where the discharge of water below pH 4.5 is unobjectionable, automatic pH adjustment of waste waters containing soluble oil is desirable. However, this does not apply where batch treatment is practiced.

The Ohio River Valley water-sanitation commission sponsored a comprehensive investigation of several procedures for treatment of phenol waste, which is a common waste problem in integrated steel mills. An important variable affecting both the efficacy and economics of treatment is pH. It was found in chlorinating phenolic wastes that it definitely was advantageous to maintain the pH of the liquor being treated between 7.0 and 10.0. However, if ozone or chlorine dioxide is employed as the oxidizing agent, the normal pH (11.5) of the still liquor is satisfactory.

The effluent from the final clarifier of an industrial waste-treatment plant usually should be monitored by a pH recorder. This provides the operator with a visual record of the final effluent characteristics and also serves as an important record in event of any dispute with regard to stream pollution.

Level Control

It is usual for steel mills to draw their raw water from surface supply. To remove large objects which might damage the intake pumps, trash screens are installed ahead of the pumps. Screening of sanitary sewage before treatment is also common. Where screening is desirable it frequently is advantageous to use mechanical equipment for removing the debris from the screens; the trash-removal equipment can be automatically started and stopped on a preset level-differential between the upstream and downstream sides. It may be desirable to install at the plant intake an instrument for indicating and recording the level of the river or lake.

Although many batch-type softeners are used in steel mills, few new installations are being made. Level alarms and controls are customary and useful on this type of softener.

Having good level control on each sedimentation tank of a hot process softener is important in order to hold the

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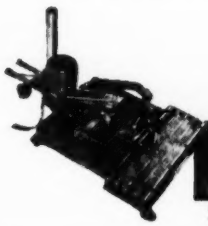

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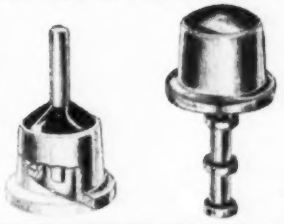

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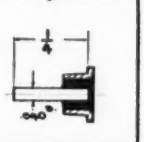	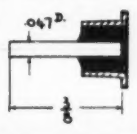	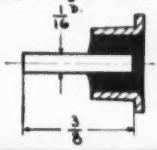
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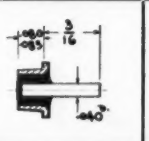	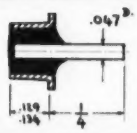	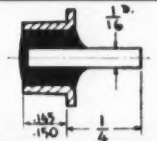
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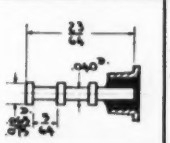	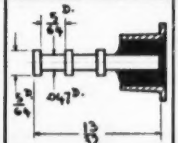	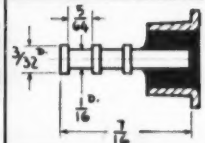
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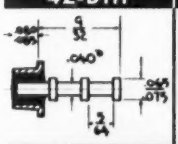	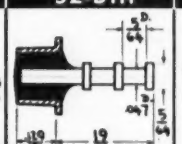	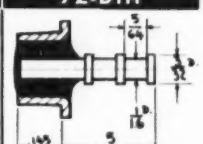
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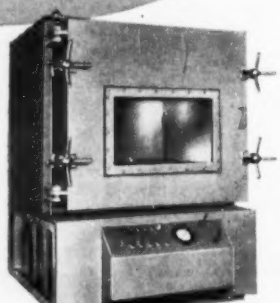

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proper hydrostatic head for good performance and to prevent loss of treated water through the overflow.

Proper level control is important in many applications of water for processing purposes. For example, level controls should be installed in all wash-water tanks to insure adequate water for the washing operation and to avoid unnecessary wastage of water.

The level of sludge in the sludge digester should be controlled within limits. The level of sludge in the pans of vacuum filters also should be indicated and controlled.

Turbidity

One of the major electrical equipment manufacturers has developed an instrument for measuring and indicating turbidity in water. The application of this instrument to water treatment should be an important step toward effective surveillance of water-treatment processes by instrumentation. For example, a turbidity detector could be assigned an on-off control function such as ringing an alarm to direct the operator's attention to a sub-standard effluent or to automatically divert the effluent to a storage basin for retreatment.

Where coagulant costs are high, or whenever clarity of effluent is critical in the operation of a sludge blanket, slurry pool, or sludge recirculation unit it is advantageous to install a turbidimeter for the indication and recording of effluent clarity; the rate of chemical feed can be adjusted to the minimum requirements for obtaining the degree of clarity desired. If a high clarity is required in the effluent from oil removal equipment, it is advantageous to control the chemical dosages by monitoring and controlling the turbidity of the effluent.

In plants where treated waste water is released to a first-class stream, it is desirable to install a turbidity recorder in the effluent stream to protect the plant from unjustifiable accusations.

Temperature

Temperature control is important in the operation of hot process softeners and deaerating heaters. Maintaining proper temperature in the water being treated in the hot process softener is necessary from the standpoints of obtaining adequate oxygen removal and the best possible hardness removal and clarification. In installations where hot process effluent is used as boiler makeup without further deaeration, temperature in the softener should be held at 212 deg. F. or higher in order to reduce the dissolved oxygen content of the treated water to a satisfactory minimum which will retard corrosion of feed lines and boilers. Of course temperature of the water in deaerating heaters should always be held at a minimum of 212 deg. F. for most efficient operation.

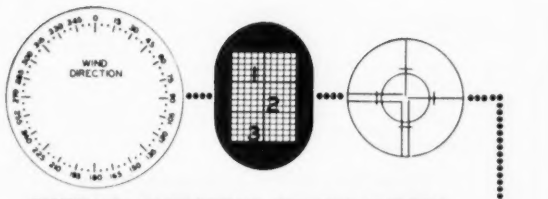
It is not uncommon to clarify either process water or waste water by plain sedimentation. If temperature varies more than 5 deg. F. from the mean during the unit's average detention time, thermal currents are likely to result and interfere with clarification. In such instances it is desirable to provide a temperature recorder to facilitate operation of the clarifier. Occasionally a controller may be justified to recycle or otherwise blend the influent and the effluent, thus minimizing the temperature swings and thermal currents.

Temperature control for cooling water is very important. This is most commonly accomplished by installation of a temperature controller in the coolant line. Temperature is often a critical variable in controlling the flow of water used for processing purposes. For good control of separately heated sewage sludge digesters it is important to record and to control the temperature of the digesting sludge.

Pressure

Pressure indicators and controllers are necessary for good operation of hot process softeners and deaerating heaters. The proper steam pressure is maintained by a pressure controller. This is important in order to attain optimum operating temperature in the incoming water and to prevent a vacuum from forming.

Where the continuous flow of water is important for protection of the equipment (such as in jacket cooling water



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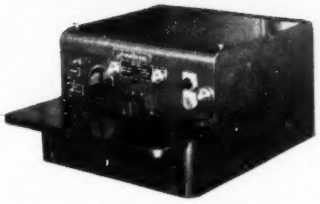

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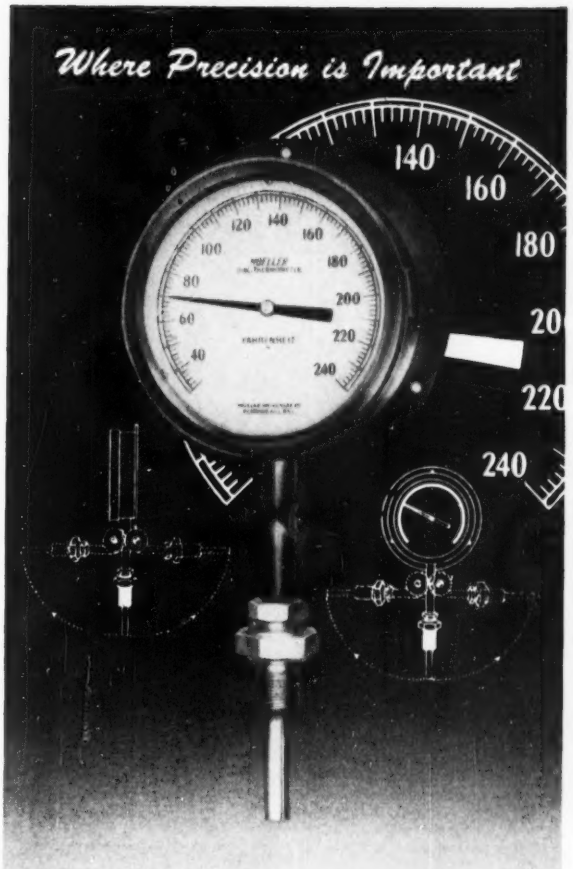

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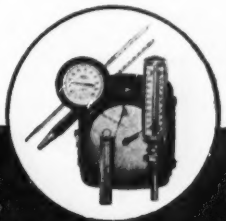

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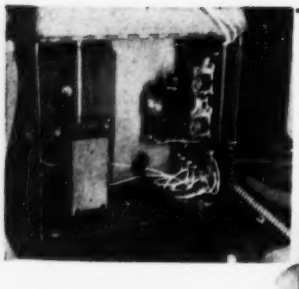

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on Diesel engines) it is wise to install pressure switches which will automatically shut down the equipment on a preset drop in cooling-water pressure.

Sludge dewatering filters should be provided with a device for indicating the vacuum applied at the surface of the filter drum.

Oxidation-Reduction

At least one plant has employed an oxidation-reduction potential controller to govern the feed of copperas and acid for reducing hexavalent chromium to the trivalent state. Complete reduction of chromium at various concentrations is achieved between 490 and 500 millivolts in an acid medium.

Almost twenty years ago Max Lavine of Iowa State University pointed out the importance of oxidation-reduction potential in operating trickling filter and activated sludge plants. Since then other investigators have defined the range of oxidation-reduction potentials required to carry out these biological processes most effectively. Within the past 5 years Eckenfelder and Hood have shown how diminishing alkalinity can be used to measure treatment-plant performance. If alkalinity can be relied on as a parameter of effective treatment in biological processes, then fluctuations in this dependent variable may make possible the control of the determining variable—oxidation-reduction potential.

A more thorough understanding of the relationships between alkalinity, oxidation-reduction potential, and treatment-plant performance could serve as a basis for controlling biological water-purification processes. Such a system would assist greatly in making oxidative procedures more dependable even during shock loads.

Chlorination

It is common in steel mills to (1) raise the pH of the raw water, (2) chlorinate, and (3) sometimes feed a glassy phosphate at a point near the intake. Several years ago an instrument for recording and controlling chlorine residuals was developed; several units have given satisfactory performance over an extended time. Especially where chlorine demands can fluctuate widely over short intervals, as they do in some steel-mill water supplies, it is extremely desirable to have good control of chlorination. Excessively high chlorine residuals can be more detrimental to a plant than sub-standard concentrations. Especially in plants where pickle liquors are a contaminant, it is impossible to maintain desired residuals without automatic control.

In chlorinating the mill effluent it is equally desirable and economical to use a chlorine residual recorder and controller.

Conductivity

The regeneration of deionizing equipment can be controlled automatically by monitoring the conductivity of the effluent. When only the cations are removed from the water, pH control can be satisfactorily applied as the basis of effluent quality. A good example of control based on conductivity is the condensate return systems of steam-generating plants in paper mills. An increasing number of Kraft mills are returning condensate from their multiple-effect black-liquor evaporators to the boilers. Until recent years, large volumes of valuable condensate were discharged to the sewer because of the hazard of damage to boiler operation by black-liquor contamination of condensate. Reuse of this valuable condensate now can be recommended so long as an automatic dump valve is installed ahead of the condensate storage tank. Normally, the evaporator condensate is returned to the boiler feed water system. However, on an adjustable preset increase in the conductivity of the return condensate the dump valve can be positioned automatically to divert the condensate to the sewer. Similar arrangements are used in other industrial plants, including steel mills, where there is a possibility of serious condensate contamination.

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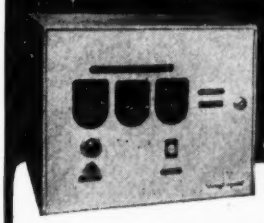

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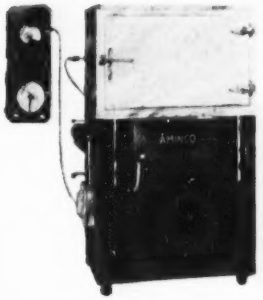

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USAF Spec. 41065-B, Grp. 30, Method 31.
Preconditioning state of 50% relative humidity and 77° F.
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Cams for other humidity or temperature programs are available.

4 Types of Humidity-Temperature Control

1. Constant humidity and constant dry-bulb temperature.
2. Constant humidity and varying dry-bulb temperature.
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4. Varying humidity and varying dry-bulb temperature.

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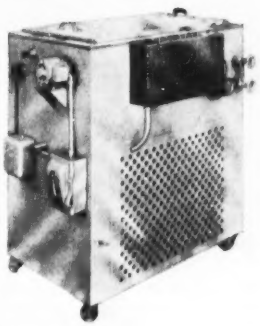

RANGE—82% to 88% relative humidity at 40°F.
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ACCURACY—Controls dew-point and dry-bulb temperatures to within plus-minus ¼°F.

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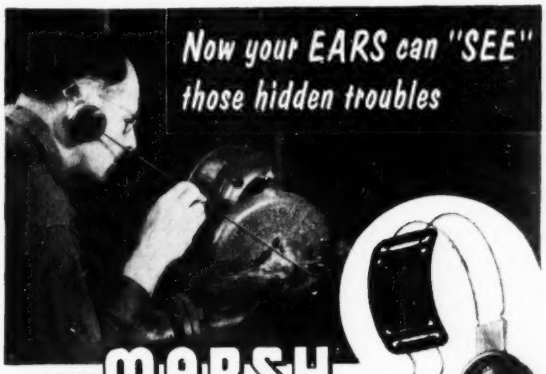

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INSTRUMENTS ON THE MARCH

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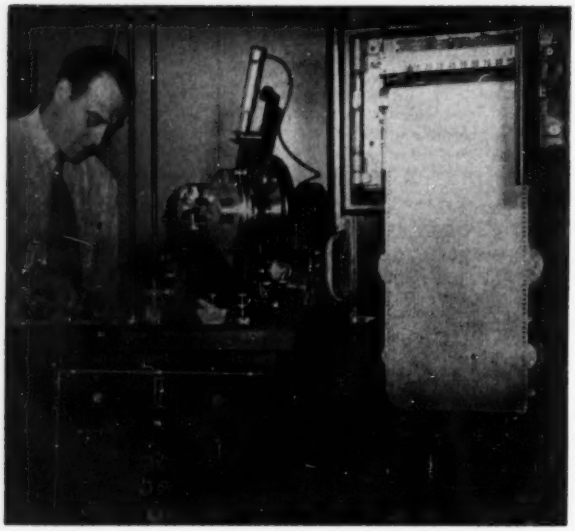
Geiger-counter Spectrometer Solves Carbon Problems

CLEVELAND, Ohio.—Paul Mail, Research Analyst, National Carbon Company Research Laboratories, Cleveland, is doing basic research involving phase relations of rare-earth compounds, crystal growth of graphite, and manganese-



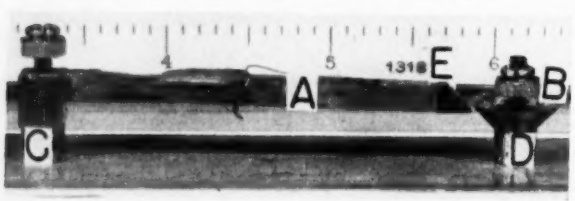
dioxide structure on X-ray diffraction equipment made by North American Philips Company, Inc. Mr. Mail is also studying product control matters connected with depolarizers for dry cells. He also handles other general analytical tasks where identification and quantitative results are required.

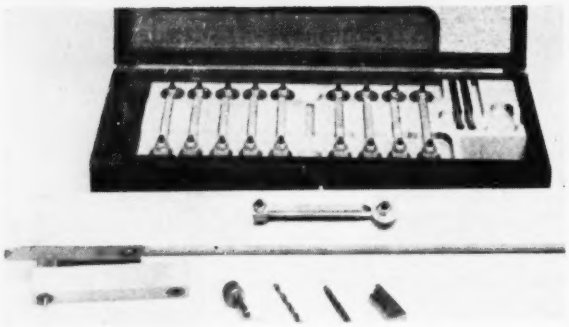
Limit Load Gage

WASHINGTON, D. C.—A limit load gage recently developed at the National Bureau of Standards provides a simple means for determining whether basic structural components of operational aircraft have been stressed beyond safe limits.

Extremely simple in principle, the gage indicates overload when the arm, initially set above the cam in a cocked position, flips past the cam. The gage is designed for mounting on a structural member by means of two holes drilled and tapped at the desired location. The accurate spacing of the holes is necessary only to insure that the arm tip will contact the cam.

The side view of the limit load gage shows its three major components: the arm A, cam B, and gage points



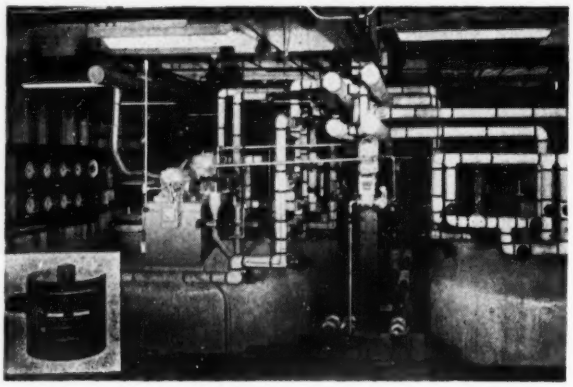


C and D. Locknuts holding A and B are tightened before use. The gage is attached to the structural member at the gage points. The hardened steel arm tip E can be set above and overlapping the cam B by a predetermined distance equal to the desired elongation which is to be indicated. When this is exceeded, the arm drops from the cam to the position shown.

The other illustration shows a set of ten NBS limit load gages, with accompanying fixtures necessary for installing the gages on the structural elements under test (made by Bowen Instrument Company).

Load Cells Control Latex Churns

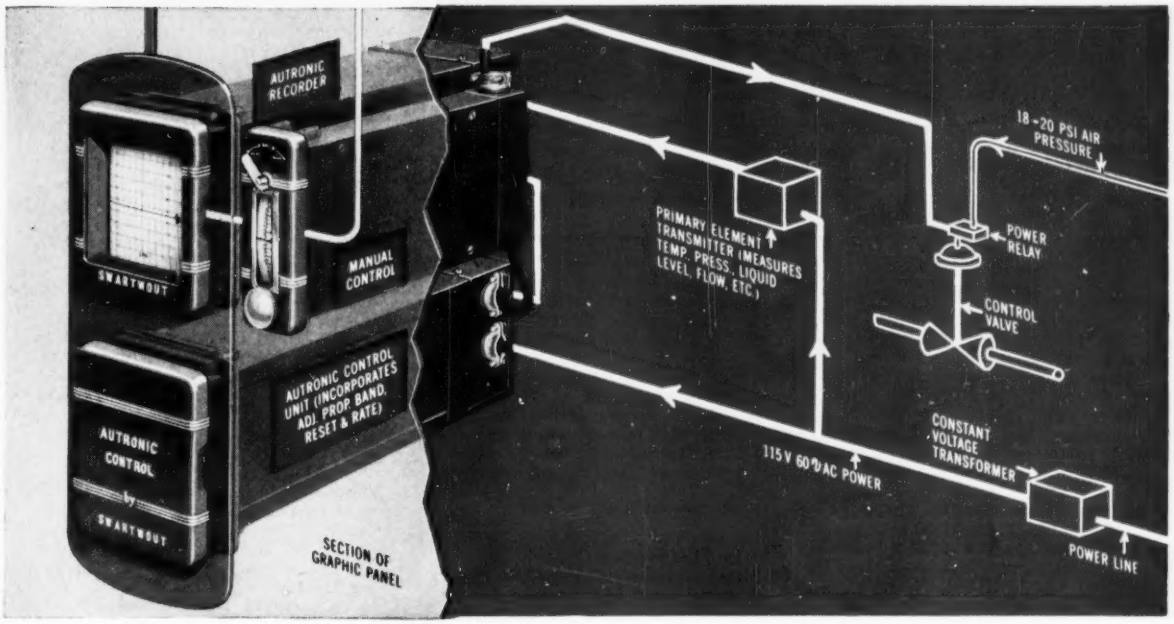
WOONSOCKET, R. I.—To assure accuracy in proportioning raw materials for foam-rubber products, the filling of these eight 2000-gallon latex churns is automatically controlled by means of Baldwin SR-4 Load Cells of 10,000-lb. capacity each. The cells, incorporating resistance-wire strain gages in a container only 3⅜ inches in diameter and



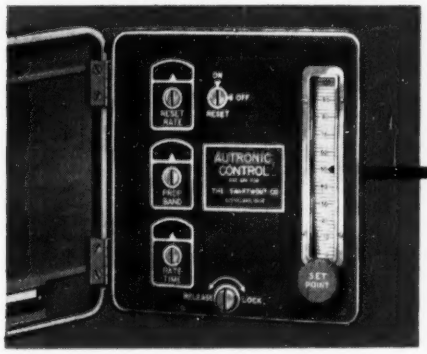
less than 4 inches high, provide one of three symmetrically placed supports for each churn.

Each load cell is connected through an 8-point switching unit to a direct-reading 20,000-lb. indicating controller (left, beyond eight temperature controllers) which operates solenoid valves in fill lines. Batch temperature is controlled by air-operated valves in hot-water lines to water-jackets around the tanks. The Baldwin automatic weighing system is in use at the Woonsocket, R. I., plant of United States Rubber Company.

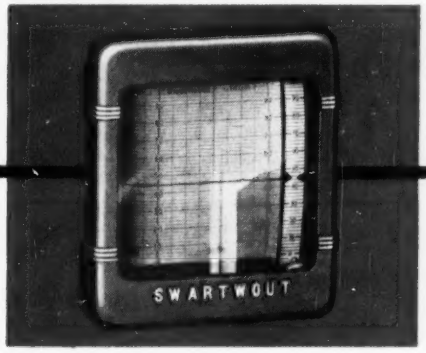
Miniature all-electronic system for instantaneous measurement and control of process variables...



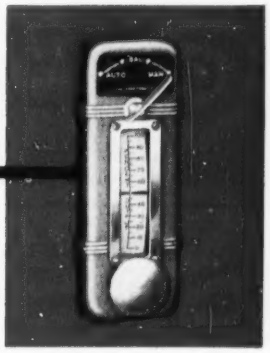
1 Regardless how fast a pneumatic or electro-mechanical system may function, it cannot compare with the *instantaneous, all-electronic* response of the Swartwout Autronic Control System. Here's why. Since transmission of information throughout the system is by *electrical means only*, there is no mechanical motion . . . no slide wires, boosters or motors to initiate control action . . . no control air lines from primary element or to final element. Hence the Autronic Control System *spans distance between primary and final elements without interval* —for closer, more accurate control. A-4940



2 **AUTRONIC CONTROLLER**, heart of the system, has no moving parts. Proportion, reset and rate-action adjustments; with or without built-in set-point adjustment. Extremely compact, plug-in type units are interchangeable; can be used direct or reverse-acting.



3 **AUTRONIC RECORDER** operates without slide wires or other contacting mechanisms. Electronically controlled pen gives true linear trace. Unit holds 1-month supply of standard 3-inch linear or square root chart paper. Set-point adjustment optional with Autronic Recorder.



4 **AUTRONIC MANUAL CONTROL** makes bumpless changeovers simple. No gauges to synchronize, no readings to remember because indicator shows *difference* between actual and desired output.

Swartwout *Autronic* **CONTROL SYSTEM**

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Manufacturers' New Literature

In this department we report new literature, pertaining to instrumentation, received from the manufacturers. We urge readers to request ONLY those bulletins which will be of value to them. Use the Postage-free Order Card on Page 623.

Requests for literature FROM ABROAD should be made on company letterhead and mailed DIRECTLY to the manufacturers.

Temperature

Thermistors. New 36-page Veco Data Book contains: introduction on thermistors; types of construction; thermal and electrical operating characteristics; temperature-resistance characteristics; voltage-current characteristics; current-time characteristics; typical uses in temperature measurement, compensation and control, in time-delay and switching devices, etc.; 17 pages of detailed characteristics of quantity-production thermistors; instruments. Price $1.00 but free to **Instruments** readers who fill out their titles on inquiry card.—Victory Engineering Corp., Union, N. J.

Mention L-415 on card

Temperature Measurement. New 20-page bulletin 53-1-49 features article on temperature measurement. Includes articles on portable pyrometers and millivoltmeters, ultra-speed electro-analyzers, microscope eyepiece cameras, "Carbotrane," and manometric microgasometers.—Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Mention L-416 on card

Industrial Temperature Control. New 24-page Bulletin 101 presents basic principles of industrial temperature control, defines different types of control systems and distinguishes between them so that engineers can select type most suited to a particular application. Discusses eight ways of responding to temperature, five ways of putting that response to work; and nine basic instrument types of maker. —The Partlow Corp., New Hartford, N. Y.

Mention L-417 on card

Strip Thermostats. New bulletin illustrates and describes maker's "Type C" bimetal strip thermostats for appliances, communications, and electronic equipment. Includes operating principle, schematic diagrams, ratings, typical performance curves, and other data.—Stevens Mfg. Co., Inc., 69 S. Walnut St., Mansfield, Ohio.

Mention L-418 on card

Pyrometers. New 12-page illustrated Bulletin GEC-713B describes design features, applications, operation, functional principles, construction, and specifications of maker's line of indicating and controlling pyrometers. Includes information on other temperature equipment including thermocouple components and accessories, hand pyrometers, thermocouple potentiometers, resistance thermometers, and industrial resistance bulbs.—General Electric Co., Schenectady 5, N. Y.

Mention L-419 on card

Temperature Controllers. New 18-page Catalog ND47 (1953) illustrates and describes maker's "Electromax" temperature and conductivity controllers. Includes control principles, applications, designs, specifications, and installations.—Leeds & Northrup Co., 4934 Stenton Ave., Phila. 44, Pa.

Mention L-420 on card

Thermometers. New 8-page Catalog 225 illustrates and describes maker's "Bimet" dial thermometers, for industry. Includes specifications, styles and price.—Moeller Instrument Co., Richmond Hill 18, New York, N. Y.

Mention L-421 on card

Thermometers. New 4-page bulletin describes and illustrates maker's thermometers for checking vats, ovens, dryers, etc. Includes prices.—Moeller Instrument Co., Richmond Hill 18, New York.

Mention L-422 on card

Pyrometer Controller. New 8-page Bulletin P1248 illustrates and describes maker's Free-Vane electronic pyrometer controller. Illustrates the unit plug-in construction of the new controllers and describes their use for low-open, high-open, low-high, low-open-high, and low-normal-high-control.—The Bristol Co., Waterbury 20, Conn.

Mention L-423 on card

Heating Panel. New 6-page folder illustrates an describes maker's electric far-infrared radiant-heating panel, suitable for heavy duty industrial, drying, and curing operations. Includes dimensions and specifications. —Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.

Mention L-424 on card

Thermocouples. New 16-page Catalog 5 illustrates and describes maker's line of thermocouples, protection tubes, thermocouple wire, lead wires, and insulators for all makes of pyrometers.—Arklay S. Richards Co., Inc., 75 Winchester St., Newton Highlands 61, Mass.

Mention L-425 on card

Recording Thermometer Controller. New illustrated 2-page Bulletin 501-S describes operation, features, and applications of new flexible temperature-time program controller with motor-driven set-point index. Includes components and specifications.—Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Phila. 44, Pa.

Mention L-426 on card

Thermometers. New 6-page Catalog A-53 illustrates and describes over 300 different laboratory and ASTM thermometers. Includes prices and contains list of ASTM, Instrument, IPT,

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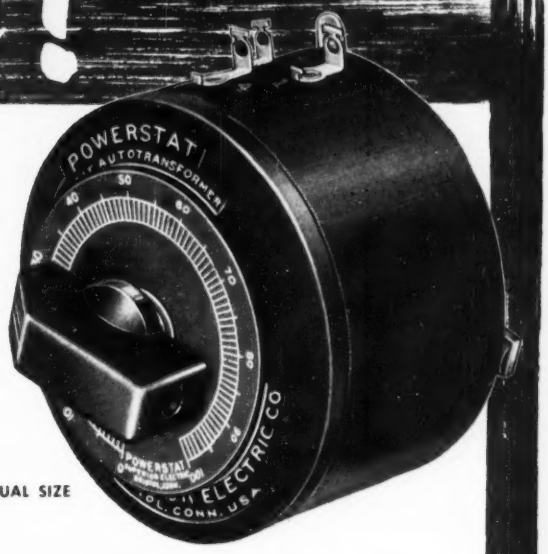

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. . . with a rheostat or other resistance type controls. You will find POWERSTAT type 10 the ideal source of variable a-c voltage control of 50-100-150 watt loads.

POWERSTAT type 10 is rated:

INPUT: 120 Volts, 60 Cycles, 1 Phase

OUTPUT: 0-120 Volts, 0-132 Volts, 1.25 Amperes, 150/165 Volt-Amperes

POWERSTAT type 10 weighs only 1 POUND, 13 OUNCES.

- **EFFICIENCY** of type 10 is high . . . does not control by dissipating power in the wasteful form of heat as does a resistance type control.
- **SPACE REQUIREMENT** of type 10 is only 2⅛ by 3⅛ inches. Not only is it compact but since it does not produce heat there is no ventilation problem.
- **CONSTRUCTION** of type 10 is rugged for long life and dependable service.
- **ADAPTABILITY** of type 10 to any load within its rating is possible without tailoring as is necessary with a resistance type control.
- **RATING** of type 10 is conservative with the rated output current available at any brush setting.
- **MOUNTING** of type 10 is simple by means of a single hole in the panel. It is locked in position by a keying arrangement.
- **OPERATION** of type 10 is smooth, stepless and silent.
- **PRICE** of type 10 is low . . . comparable to any other type of a-c voltage control apparatus of equal capacity and characteristics.

A comparison of POWERSTAT type 10 with a rheostat or other resistance type controls reveals that it is the logical answer to any variable a-c voltage control problem involving loads up to 150 watts.

POWERSTAT type 10 is a small, compact autotransformer of toroidal core design with a movable brush-tap. Rotation of the tap delivers any output voltage from zero to, or above, line voltage. It is tapped to allow compensation for a 10 per cent drop in line voltage.

Additional information on POWERSTAT type 10 is available by writing **704 Mae Avenue, Bristol, Conn.**

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From Alden's Line of Ready-made Components for Unitized Plug-in Unit Construction:

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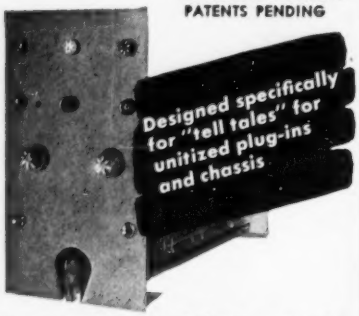
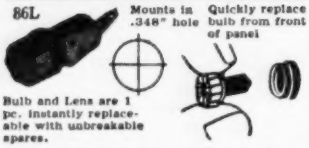


The new trend to unitized plug-in construction calls for tiny sensing and monitoring devices to act as "telltales" when trouble occurs. Device must be rugged, yet take a minimum of panel space. Here are latest in Alden Series to meet this problem.

ALDEN "PAN-i-LITE"



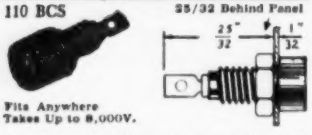
Bulb and Lens are 1 pc. instantly replaceable with unbreakable spares.

You can use this new tiny Alden Pan-i-Lite indicator where never before possible. Easily serviced one-piece lens-bulb replaceable from front of panel. Mounts simply by pushing into .348" hole. Gives beautiful indication; glows like a red hot poker. Tiny spares can always be kept ready in kit or taped in recess of equipment. Available in 6V, 12V and 28V, various colors.

ALDEN "FUSELITE"

Spot trouble instantly. Neon indicator light in lens glows when fuse blows. One-piece molded lens-and-indicator-lite unscrews from front of panel. Ideal for monitoring power to each unitized circuit. Available for 28V, 110V and 250V.

ALDEN TEST POINT JACK



Provides a quick front panel check point for any circuit voltages in your equipment. This tiny Jack fits .257" hole and takes only 25/32" behind panel. Beryllium copper contact withstands hundreds of insertions. Phenolic or nylon insulation, many colors.

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MANUFACTURERS' NEW LITERATURE

and Gas Chemist thermometers.—Brooklyn Thermometer Co., 217-09 Merrick Blvd., Springfield Gardens, N. Y.

Mention L-427 on card

Controlling Pyrometers. New 4-page Bulletin G-2 illustrates and describes maker's "Sim-Ply-Trol" controlling pyrometers for automatic continuous direct indicating and control of temperature. Includes prices and ranges.—Assembly Products Inc., Chagrin Falls 3, Ohio.

Mention L-428 on card

Potentiometers. New 6-page illustrated Brochure 10952 describes unitized construction of maker's line of precision potentiometers including applications, specifications and operation.—Servotrol Co., 114 W. Illinois St., Chicago 10, Ill.

Mention L-429 on card

Thermocouple Technique. New 4-page review by F. D. Dodge presents approved techniques for proper installation of thermocouples for measuring boiler-tube temperatures. Includes installation methods and illustrations.—Minneapolis-Honeywell Regulator Co., Industrial Div., Phila. 44, Pa.

Mention L-430 on card

Pyrometers, Thermometers, Tachometers. New 2-page illustrated Specification Sheet 115 describes indicating pyrometers, resistance thermometers and tachometers of high-resistance millivoltmeter type. Includes construction and engineering details.—Minneapolis-Honeywell Regulator Co., Industrial Div., Phila. 44, Pa.

Mention L-431 on card

Temperature Control. New 2-page bulletin illustrates and describes maker's "Model B-1C" temperature control for laboratory use, low-temperature oven control, heating and air conditioning, and controlling between minus 300 and plus 300 F.—Burling Instrument Co., 5 Vose Ave., South Orange, N. J.

Mention L-432 on card

Optical Pyrometer. New Bulletin 15-1152 illustrates and describes maker's new "Rayotube" for high-frequency induction heating. Permits direct temperature measurement and can be operated at temperatures to 350 F.—Leeds & Northrup Co., 4901 Stenton Ave., Phila. 44, Pa.

Mention L-433 on card

Tank Thermometers. New 4-page illustrated brochure describes maker's thermometers designed especially for tankage gaging. Includes models, ranges, specifications, and prices.—Moeller Instrument Co., 132 St. and 89 Ave., Richmond Hill 18, N. Y.

Mention L-434 on card

Temperature Controllers. New 4-page Catalog G-18 illustrates and describes maker's line of electric-contact temperature controllers including new Models A-1S and B-1C, and a separate description of the company's pneumatic and valve type controllers. Includes a selection and comparison table showing essential features of the 17 controllers.—Burling Instrument Co., 5 Vose Ave., S. Orange, N. J.

Mention L-435 on card

Electric Immersion Heaters. New 4-page Bulletin 15 describes and illustrates maker's "Vitreosil" electric immersion heaters of fused silica for heating acid baths. Includes features, applications, specifications, prices and acid containers.—The Thermal Syndicate, Ltd., 14 Bixley Heath, Lynbrook, N. Y.

Mention L-436 on card

Pressure

Pilot Regulator. New 4-page Bulletin 614 illustrates and describes maker's new twin-nozzle pilot regulator which controls pressures from ounces to 1000 lbs.—Natural Gas Equipment, Inc. Distributors, 190 E. Glenarm St., Pasadena, Calif. (Wilgus Manufacturing Co.)

Mention L-437 on card

Pressure Regulator. New bulletin illustrates and describes maker's "1000 PR-4" pressure regulator for providing a means of maintaining airborne pressurized radar systems at sea level pressure under all conditions of altitude. Includes specifications and outline dimensions.—APCO, 617 Putnam Dr., Whittier, Calif.

Mention L-438 on card

Manometers. New 4-page brochure illustrates and describes maker's "Red Line" manometers for use in petroleum, aviation, dairy, and other industrial fields. Included are well-type, absolute-pressure, and U-tube manometers. Also indicating flow meters, orifice flanges, and plates.—Trimount Instrument Co., 3119 W. Lake St., Chicago 12, Ill.

Mention L-439 on card

Gas Leak Detector. New illustrated bulletin describes new "Leak-Tec" liquid for detecting minute gas leaks by bubble technique.—Cargille Scientific Inc., 117 Liberty St., New York 6, N. Y.

Mention L-440 on card

Pressure Control. New 12-page Bulletin S-22-CA illustrates and describes maker's complete line of pressure regulating valves and pressure master controls. Includes cutaways, section views, dimensions, and specifications. Describes in detail diaphragm-operated spring-opening and spring-closing regulating valves, pressure controllers, air locks, valve positioners, and selector panels.—The Swartwout Co., 18511 Euclid Ave., Cleveland, Ohio.

Mention L-441 on card

Flow

Orifice Plates and Plate Holders. New Catalog Section G illustrates and describes maker's precision-machined orifice plates and plate holders for measurement and control of liquids and gases.—Daniel Orifice Fitting

Co., 3352 Union Pacific Ave., Los Angeles 23, Calif.
Mention L-442 on card

Sight Flow Indicators. New bulletin illustrates and describes maker's full-view sight flow indicators for avoiding shutdowns by seeing what goes on in pipelines.—Jacoby-Tarbon Corp., 808 Nepperhan Ave., Yonkers, N. Y.
Mention L-443 on card

Flowmeter. New 18-page bulletin 401 illustrates and describes maker's new "Type H" differential-type flowmeter for use in metering a wide variety of fluids. Includes construction, technical information and specifications.—Simplex Valve & Meter Co., 68th and Upland Sts., Phila. 42, Pa.
Mention L-444 on card

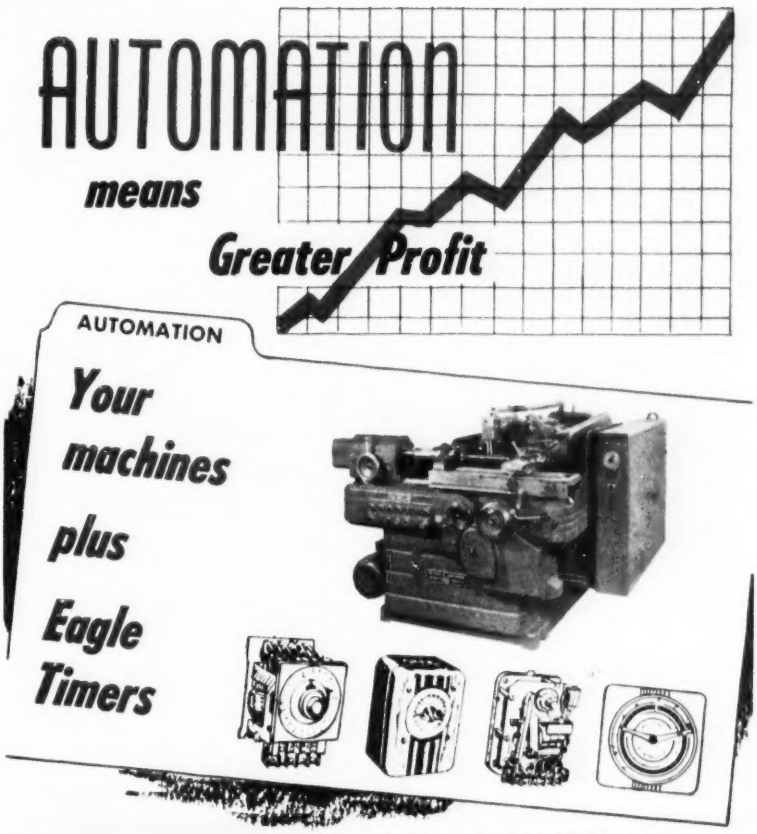
Flowmeter. New 6-page Bulletin 201 illustrates and describes maker's "Flo-Meter," a precision instrument for indication of rates of flow of air and industrial gases. Includes principle of operation, and installation design.—Waukee Engineering Co., 759 N. Milwaukee St., Milwaukee 2, Wisc.
Mention L-445 on card

Flowmeters. Set of 7 new specification sheets in consolidated style covers flowmeter line. Specification Sheet 241 and 242 cover electric evenly-graduated flowmeter bodies and mechanical evenly-graduated flowmeters. Specification Sheets 243 through 247 cover square-root flowmeters and liquid-level meters. Specification Sheet 244 also includes evenly-graduated electric flowmeters (inductance bridge receivers). Construction and engineering details are included. —Minneapolis-Honeywell Regulator Co., Industrial Div., Sta. 64, Phila. 44, Pa.
Mention L-446 on card

Process Control

Cooling Units. New 12-page brochure describes and illustrates maker's cooling units for alloy steel heat treatment, metal stabilization, gas dehydration and parts and material testing. Includes specific treatment and heat-cold cycles for transformation of austentite to martensite for water and oil hardening tool steel, alloy carburizing steels, high alloy die steels and high speed and moly type steels.—Sub-Zero Products Co., Reading Rd. at Paddock, Cincinnati 29, Ohio.
Mention L-447 on card

Self-balancing Recorders and Controllers. New 40-page Catalog ND44 (1) describes in detail the design and construction of maker's strip-chart "Model S Micromax" recorder for continuous measurement control of key process variables such as temperature. Includes interior views of instruments and illustrates and describes the sequency of galvanometer detection, typical circuits used, standard features found in the basic "Micromax" instrument and special features available to broaden the application of "Micromax."—Leeds and Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.
Mention L-448 on card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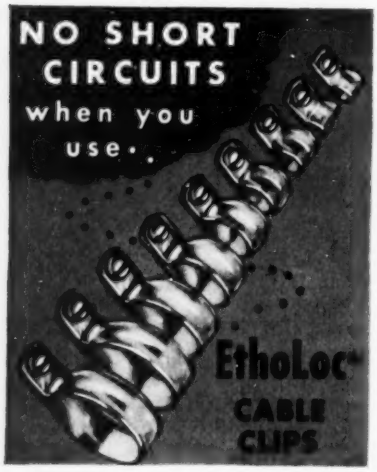

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MANUFACTURERS' NEW LITERATURE

Electronic Controllers. New 56-page Catalog 1530 illustrates and describes all types of maker's "ElectroniK" control instruments which are used to measure and control process variables. Includes detailed specification and control action descriptions and ratings for both electric and pneumatic type controllers. Also presents engineering data on "Electr-O-Line" and "Electr-O-Pulse" control relays.—Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.
Mention L-449 on card

Indicating Instruments. New 24-page Bulletin 98214 describes and illustrates maker's 6-in. dial indicators for temperature, pressure and load applications. Includes dials and scales available, reference material on different types of actuation, explanation of sensitive elements or bulbs, and recommended applications for each, and mounting dimensions for different types of instruments.—Taylor Instrument Companies, Rochester 1, N. Y.
Mention L-450 on card

Pneumatic Receivers. New 4-page specification sheet 285 illustrates and describes maker's pneumatic receivers, which are furnished as indicating controllers, recorders, and recording controllers. Construction and engineering details are included.—Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.
Mention L-451 on card

Industrial Instrument Applications. New 28-page "Taylor Technology" Vol. 5, No. 3, features article on engineer's instrumentation lectures in the Middle East. Includes articles on industrial thermometers, holding humidity within plus and minus 1 percent, differential-pressure transmitter, salt, and force-balance pressure transmitters used to detect column flooding. —Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y.
Mention L-452 on card

Dewpoint Equipment. New 8-page illustrated Bulletin GEC-588A describes maker's dewpoint measuring equipment for continous indication and recording of dewpoint temperature in a gas stream. Includes diagrams, applications, and operation principles.—General Electric Co., Schenectady 5, N. Y.
Mention L-453 on card

Nuclear Gaging. New 4-page issue Vol. 1, No. 2, of "Nucleonics Views" features article on use of maker's "AccuRay" gages in calendering plastic materials, in process analysis, and in tire manufacture.—Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus, Ohio.
Mention L-454 on card

Time Cycle Control. New 4-page bulletin illustrates and describes maker's automatic time cycle control hydraulic sequence operation for the process industries. Includes features and sizes available.—The Gas Machinery Co., 16100 Waterloo Rd., Cleveland 10, Ohio.
Mention L-455 on card

Air-operated Controller. New 32-page Bulletin A120 illustrates and describes maker's "Series 500 Free-Vane" air-operated controllers. Instruments for automatic control of pressure, temperature, liquid level, flow, humidity, and electrical variables are also described. New products included are time-program controllers and electronic Dynamaster potentiometers and bridge instruments in air-operated control models.—The Bristol Co., Waterbury 20, Conn.
Mention L-456 on card

Circular-case Controllers. New 16-page Bulletin 465 illustrates and describes maker's large line of circular-case controllers with on-off or proportional control action. Includes principles, construction, selection of control action, measuring systems, control valves, accessories, air controllers, and electric controller.—The Foxboro Co., Foxboro, Mass.
Mention L-457 on card

Process Instrumentation. New 8-page issue Vol. 12 No. 4 of "Modern Precision" features article on console temperature indicator, integrated control aids in soaking-pit operations, automatic instrumentation in thermostatic-devices tests, and use of resistance bridges for aid in quality in resistors.—Leeds & Northrup Co., 4907 Stenton Ave., Phila. 44, Pa.
Mention L-458 on card

Servomechanisms. New 20-page article by K. C. Mathews and R. C. Boe is "Application of Nonlinear Techniques to Servomechanisms." Represents first experimental verification of multiple-mode operation as applied to a given servo system. Includes principles of operation, determination of constants, design, description of system, and results.—Cook Research Laboratories, 8100 Monticello Ave., Skokie, Ill.
Mention L-459 on card

Level, Pump Control. New 4-page Bulletin 3500 illustrates and describes maker's "Type M Selectrols," multi-circuit float controls that coordinate operation of pumps, valves, gates, alarms, and indicators. Includes features, specifications, and applications. —Automatic Control Co., 1005 University Ave., St. Paul 4, Minn.
Mention L-460 on card

Viscometers. New 8-page Bulletin V-1000E illustrates and describes maker's viscometers for recording or controlling of viscosity in industrial plants. Includes design and principle of operation.—Norcross Corp., Newton 58, Mass.
Mention L-461 on card

Instrumentation—Industrial Instrument Applications. New 40-page issue of "Instrumentation" Vol. 6 No. 4 features article on the Climatic Hangar—the world's largest extreme-temperature test chamber for functional testing of aircraft and many

types of military ground equipment. Additional articles on bleaching pulp, monitoring minute flows of process fluids, instrumentation in the petroleum industry, metering gas flow and others.—Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Phila. 44, Pa.

Mention L-462 on card

Optical Instruments

Reflectance Standards. New 2-page Bulletin 118 describes new method of recalibration of master sets of nonselective reflectance standards.—Gardner Laboratory, Inc., Bethesda, Md.

Mention L-463 on card

Camera. New 4-page brochure illustrates and describes maker's "Hulcher 70" high-speed sequence camera which provides 25 five-inch pictures per second on 70 mm film.—Charles A. Hulcher Co. Inc., Sequence Cameras, 40 Manteo Ave., Hampton, Va.

Mention L-464 on card

Auto-Collimator. New 2-page Product Bulletin 01 illustrates and describes maker's new "Model 4 Jackknife" auto-collimator for measurement of angles, parallelism, and surface quality.—The Perkin-Elmer Corp., Norwalk, Conn.

Mention L-465 on card

Photoelectric Recorder. New 12-page illustrated Bulletin GEA-5536 describes applications of photoelectric recorder in seismology, psychology, textile, metals, fatigue and research testing equipment, detection of pipeline corrosion, and other uses. Includes listing of recorder's rating.—General Electric Co., Schenectady 5, N. Y.

Mention L-466 on card

Laboratory Apparatus

Laboratory Equipment. New 930-page "Catalog B" illustrates, lists, and describes distributor's complete line of laboratory equipment and apparatus for assay, chemical, clinical, biological, bacteriological, materials testing, and metallurgical laboratories. Reply only on company or institutional letterhead.—Arthur S. LaPine & Co., 121 W. Hubbard St., Chicago 10, Ill.

Mention L-467 on card

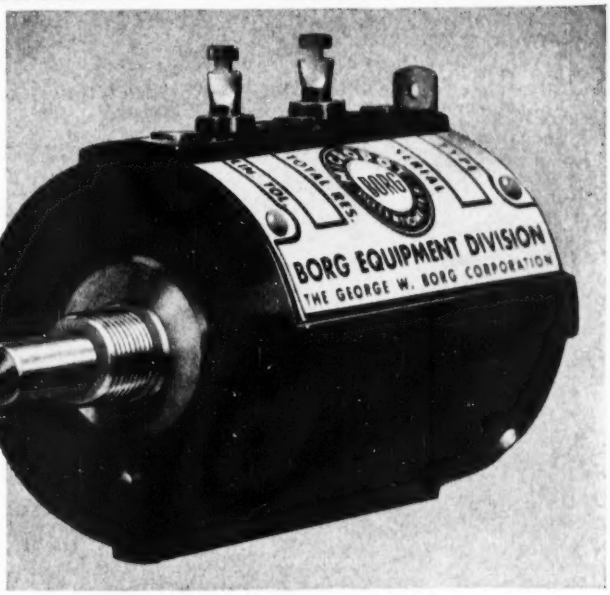
Scientific and Industrial Instruments. New 8-page Bulletin 10 features new spectrophotometric techniques for silicate mineral analysis based on maker's "Model DU" spectrophotometer. Also includes story on electronic analog simulating equipment.—Beckman Instruments Inc., South Pasadena 3, Calif.

Mention L-468 on card

Radiation Protection. New 12-page Catalog G-6 illustrates and describes maker's line of instruments for protection from radiation. Includes direct reading dosimeters, pocket chambers, roentgen-meters, midget chambers, analysis units, and slow-neutron dosimeters.—Landsverk Electrometer Co., 550 W. Garfield Ave., Glendale 4, Calif.

Mention L-469 on card

THE HIGH-PRECISION LINEAR POTENTIOMETER



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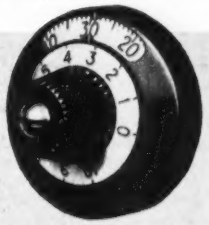
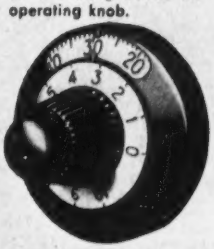


BORG MICRODIAL 746-A

A precision ten-turn indicating dial assembly. Has screw locking device on operating knob.



BORG MICRODIAL 746-B

Same as 746-A but has knurled locking screw mounted externally to operating knob.

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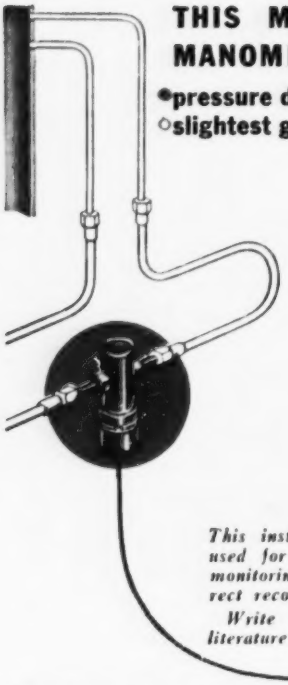

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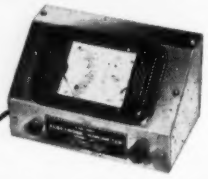

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Manufacturer's New Literature

Monochromatic Colorimeter. New 4-page bulletin illustrates and describes maker's improved "Model 35" monochromatic colorimeter with transmission type interference filters for use in clinical and general analytical work, biochemical determinations, pharmaceutical analyses, foods and fats analyses, and metallurgical analyses. Includes specifications and ordering information.—Bausch & Lomb Optical Co., Rochester 2, N. Y.

Mention L-470 on card

6-Unit Extraction Rack. New bulletin illustrates and describes maker's new 6-unit extraction rack which eliminates rheostat and heater difficulties in digestions and distillations. Also information on 6-unit utility heating rack and a utility warmer plate.—Labline Inc., 217 N. Desplaines St., Chicago 6, Ill.

Mention L-471 on card

Glass Volumetric Apparatus. New 20-page Bulletin 52-6-47 features article on the care and handling of glass volumetric apparatus. Also includes articles on modern torsion balances, separatory funnels, B&L juice refractometer, air velocity meter, speed press for mounting metal specimens, counter-rotating mixer, and an electric vacuum oven.—Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Mention L-472 on card

Testing Instruments. New 48-page 1953 Catalog illustrates and describes maker's testing instruments for the paint and other industries. Includes information on viscosity, constant temperature baths, film applicators-film thickness, precision glossmeters, miscellaneous testing devices and other related material.—Gardner Laboratory, Inc., Bethesda, Md.

Mention L-473 on card

Controlled Solution Feeder. Engineering Data sheet, AED 000-10 illustrates and describes maker's controlled solution feeder designed for application to the Lapp Pulsafeeder Pump to permit automatic feeding of treating chemicals.—The Foxboro Co., Foxboro, Mass.

Mention L-474 on card

Induction Furnaces. New 40-page Scientific Apparatus Catalog illustrates and describes maker's induction furnace series: IH-10C for carbon analyses, IH-10S for sulfur analyses, and IH-15 for carbon and sulfur analyses. Includes 8-page insert of price and recommended equipment list.—Laboratory Equipment Corp., St. Joseph, Mich.

Mention L-475 on card

Chromatography Apparatus. New 16-page catalog illustrates and describes maker's apparatus and equipment, featuring a complete listing of paper partition chromatography equipment. Includes many other newly introduced laboratory apparatus—pumps, filters, ovens, etc.—Schaar and Co., 754 W. Lexington St., Chicago 7, Ill.

Mention L-476 on card

Atomic Chart. New 4-page bulletin describes maker's fourth edition of "Chart of the Nuclides," that lists nearly 1300 different kinds of atoms on 26 x 50 inch chart. Includes 8-page description booklet.—General Electric Co., Dept. 2-119, Schenectady, N. Y.

Mention L-477 on card

Laboratory Furniture. New 22-page 1953 Catalog illustrates and describes maker's line of modern laboratory furniture. Includes general specifications, construction details, and finish. Also suggestions for laboratory layouts.—Chicago Apparatus Co., Chicago 22, Ill.

Mention L-478 on card

Electronic Titrations. New 40-page manual provides background information, instructions, and methods for the "Titrimeter," a universal laboratory instrument for fast, accurate electronic titrations. Includes chapters on potentiometric titration; installation; care and use of electrodes, and other pertinent subjects.—Price $2.00—Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Mention L-479 on card

Chemicals. New 16-page booklet lists maker's complete line of chemicals available for laboratory or manufacturing use. Includes reagent grade

and practical grade. Also introduces new resins, plasticizers, adhesives, modified and synthetic oils, wetting agents and detergents, organic synthesis, and esterification catalyst. Includes prices.—Jasonols Chemical Corp., 1085-87 Myrtle Ave., Brooklyn 6, N. Y.

Mention L-480 on card

Crystal Model Kit. New 4-page Bulletin D-3040 covers principles, operation and application of maker's crystal model kit for demonstrating crystal structure in three dimensions. Includes illustrations.—Harshaw Scientific, Div. of Harshaw Chemical Co., Cleveland 6, Ohio.

Mention L-481 on card

Laboratory Apparatus. New 4-page Bulletin D-3175 describes and illustrates maker's six-unit heating rack for multiple extraction, distillations and digestions, and utility heating. Also information on maker's "Synchro-lectric" viscometer, spectrophotometer, Harvard trip balance, and Neotex matting. Includes illustrations.—Harshaw Scientific Div. of Harshaw Chemical Co., Cleveland 6, Ohio.

Mention L-482 on card

Laboratory Furnaces. New 18-page Bulletin 1000 illustrates and describes maker's complete line of laboratory apparatus, including furnaces, combustion control, carbon determinator, timer, and accessories.—Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

Mention L-483 on card

Atomic Weights. New pocket-size atomic weight chart, Form 1518, includes atomic weights, abbreviations, and 1952 revisions. Includes mass numbers of most stable known isotope for americium, astatine, berkelium, etc.—Mallinckrodt Chemical Works, Mallinckrodt St., St. Louis 7, Mo.

Mention L-484 on card

Laboratory Apparatus. New 20-page issue No. 53-3-50 of the "Eberbach Announcer" features article on the Naval Medical Research Institute. Also articles on a camera with reflex back for B&L photomicrographic equipment, laboratory glassware washer, and a portable specimen polisher.—Eberbach & Son Co., 200 E. Liberty St., Ann Arbor, Mich.

Mention L-485 on card

Analytical Instruments

X-Ray Spectrometry. New 4-page folder titled "X-ray Checking of Substitute Materials" explains the use of x-ray diffraction and x-ray spectrometry in handling difficult laboratory and production line tasks.—Research and Control Instruments Division, North American Phillips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Mention L-486 on card

X-Ray Diffraction. New folder titled "The Case of the Bolted Door," reprint of an article from a national magazine, describes a case where x-ray diffraction furnished basic evidence in a robbery prosecution—Re-

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NEW INSTRUMENTS

search and Control Instruments Division, North American Phillips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Mention L-487 on card

Infrared Gas Analyzers. New 8-page bulletin illustrates and describes maker's infrared gas analyzer Model 21 for permanent installation for continuous plant stream analysis. Includes controls, installation, maintenance, and specifications.—Liston-Becker Instrument Co., Inc., Stamford, Conn.

Mention L-488 on card

Spectrometers. New General Catalog illustrates and describes maker's analytical mass spectrometer, isotoperatio mass spectrometer and dual-purpose mass spectrometer. Includes principles, results and functions.—Consolidated Engineering Corporation, 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Mention L-489 on card

Mass Spectrometer. New 4-page Bulletin CEC-1824 illustrates and describes maker's "Model 21-610" mass spectrometer tailored to the needs of the oil refinery, chemical plant, and laboratory. Includes operation, process monitoring and control, and structural information.—Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Mention L-490 on card

Hydrocyanic Acid Gas Detector. New 2-page bulletin illustrates and describes maker's new hydrocyanic acid gas detector for protecting personnel from unnecessary exposure to toxic concentrations of HCN. Includes operation.—Mine Safety Appliances Co., Braddock, Thomas, and Meade Sts., Pittsburgh 8, Pa.

Mention L-491 on card

Spectrochemical Laboratory. New 4-page bulletin illustrates and describes maker's "Spec Lab" spectrochemical laboratory for production control requirements with a full complement of instruments required to perform rapid and precise analyses of all except the most complex spectra. Includes installation and instruction.—Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

Mention L-492 on card

Grating Spectrographs. New 12-page Catalog i-5 illustrates and describes maker's apparatus for precision analysis with automatic grating spectrographs. Includes features, operation, characteristics, diagrams, and comparative characteristics.—Jarrell-Ash Co., 165 Newbury St., Boston 16, Mass.

Mention L-493 on card

Infrared Analysis. New 8-page issue of "Instrument News" Vol. 4, No. 2 features article on "Process Control For The Chemical Industry." Includes information on universal double-pass spectrometer, and continuous process analyzers.—Perkin-Elmer Corp., Nor-Wolk, Conn.

Mention L-494 on card

Wavelength Spectrometer. New 4-page Bulletin CH358 describes and illustrates English-made Hilger & Watts wavelength spectrometer with constant deviation prism that is useful for teaching spectrometry. Includes information on accessories.—Jarrell-Ash Co., 165 Newbury St., Boston 16, Mass.

Mention L-495 on card

Spectrometers, Monochromators. New 12-page Bulletin 158-52 illustrates and describes maker's wavelength spectrometers and monochromators, including quartz monochromator, precision wavelength spectrometer, infrared spectrometer, etc. Includes specifications and applications. —The Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill.

Mention L-496 on card

X-ray Analysis. New 8-page article reprint details historical development of X-ray analysis techniques and theory. Includes comment on the Fourier syntheses, strip methods, Bragg's analogs, X-RAC, Patterson Analysis and criteria for structure analysis. Also illustrations and diagrams.—North American Philips Co., Inc., 750 South Fulton Ave., Mount Vernon, N. Y.

Mention L-497 on card

Specific Gravity. New 2-page Circular 53-HLM illustrates and describes maker's heavy liquids for determination of specific gravity of minerals, gems, and other substances. Includes technique for use and classifications of minerals.—R. P. Cargille Laboratories, Inc., 117 Liberty St., New York 6, N. Y.

Mention L-498 on card

Spectrophotometer. New 8-page issue No. 10 of the "Beckman Bulletin" features article on silicate analyses. Also article on spectrophotometer in insecticide study, and "Reducing Background Absorption in the Infrared."—Beckman Instruments, Inc., S. Pasadena 3, Calif.

Mention L-499 on card

Microphotometers. New 12-page Catalog M10-51 illustrates and describes maker's recording and non-recording comparator microphotometer for rapid identification of lines in qualitative analysis and for accurate measurement of the blackness of lines in spectrum to permit precise quantitative analysis.—Jarrell-Ash Co., 165 Newbury St., Boston 16, Mass.

Mention L-500 on card

Electrical & Electronic Instruments

Frequency Comparators. New 4-page Bulletin 30 illustrates and describes maker's production and single frequency comparators for inspecting ferrous materials or parts, and dual frequency comparator for inspecting both ferrous and non-ferrous metals. —Magnetic Analysis Corp., 42-44 12th St., Long Island City 1, N. Y.

Mention L-501 on card

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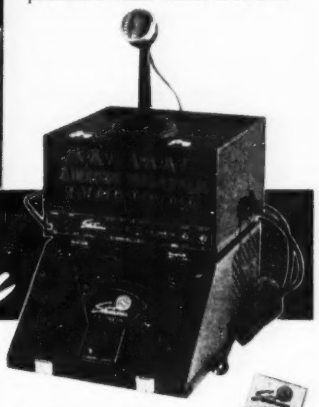

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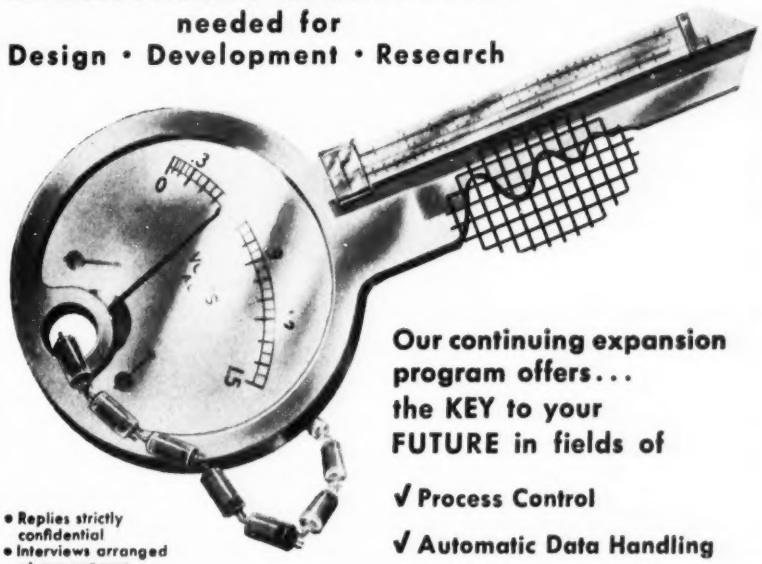

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Manufacturer's New Literature

UHF Measurement. New 12-page bulletin illustrates and describes maker's complete line of equipment for measurements at ultra-high frequencies. Includes details of an integrated system, pictures, prices, and specifications.—General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Mention L-502 on card

UHF Measuring Equipment. New 6-page bulletin illustrates and describes maker's integrated system for UHF measurements, a convenient way to measure impedance, voltage, power, VSWR, attenuation, and reflection coefficient.—General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Mention L-503 on card

Variable-Reluctance Seismometer. New bulletin illustrates "Benioff" horizontal seismometer now available from —The Geotechnical Corp., 3712 Haggar Dr., Dallas, Texas.
Mention L-504 on card

Oscillators. Two new 2-page illustrated brochures present features, specifications, and applications of maker's sweeping oscillators and "Decavider" frequency converters for converting any frequency range from 10 to 250 Mc. to 0-10 Mc. band.—Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.
Mention L-505 on card

Noise Generator. New bulletin illustrates and describes maker's "Model 1000" microwave noise generator for use in field testing, checking and maintaining performance of radar and microwave receivers. Includes features, specifications, and frequencies available.—Telechrome Inc., 88 Merrick Road, Amityville L. I., N. Y.
Mention L-506 on card

Color Television Test Equipment. New 10-page brochure illustrates and describes maker's new line of color-television test equipment. Includes data on basic units available and additional information on maker's "Model 300-A" picture generator for "Television picturemaking without a camera."—Telechrome Inc., 88 Merrick Road, Amityville, L. I., N. Y.
Mention L-507 on card

Electronic Test Equipment. New 12-page booklet illustrates and describes maker's line of test equipment for radio, television, electrical, industrial and laboratory needs. Includes price bulletin and features of available equipment.—Precision Apparatus Co. Inc., 92-27 Horace Harding Blvd., Elmhurst, N. Y.
Mention L-508 on card

Ruggedized Electric Indicators. New 4-page Bulletin 693-137 illustrates and describes maker's ruggedized meters built to MIL-M-10304 spec's, which can function in installations subject to violent vibration, bounce, and pulsation. Includes construction and specifications.—Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Mention L-509 on card

ITV. New 16-page booklet CTV-1016 supplies technical information on deflection-circuit components for maker's "6198 Vidicon," a new small camera tube for industrial-television applications. Includes recommended circuits, application, and components.—Tube Dept., Radio Corporation of America, Harrison, N. J.
Mention L-510 on card

VTVM. New 2-page illustrated brochure describes maker's vacuum-tube volt-ohmmeter for visual dynamic signal tracing. Includes features, details on high-voltage probe, high-frequency r-f. probe, and new fingertip control r-f. probe.—Electronic Designs, 28 School St., Yonkers, N. Y.
Mention L-511 on card

Galvanometer Selection. New bulletin describes selection and use of galvanometers for use with maker's pickups. Includes section dealing with circuits and calculation of damping resistance.—Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Mention L-512 on card

Sweeping Oscillator. New 2-page brochure illustrates and describes maker's decade-switched sweeping oscillator with 10-Mc. steps and visual display of band-pass characteristics for observation and measurement with oscilloscope. Includes specifications.—Decade Instrument Co., Box 153, Caldwell, N. J.
Mention L-513 on card

Microwave Gain Set. New 4-page brochure with 2-page insert illustrates and describes maker's microwave gain set, a complete system for making precision measurements of gain or loss in microwave components or systems. Includes specifications and data on new type sweeping oscillators and "Multi-Pulser," a new multi-pulse signal generator.—Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.
Mention L-514 on card

Pistol-type VOM. New bulletin illustrates and describes maker's new electronic "Meta-Gun" precision volt-ohmeter in gun form, which consists of volt-ohmeter with D'Arsonval meter set in the back of compact case with pistol grip. Includes specifications.—Jersey City Technical Laboratory, 880 Bergen Ave., Jersey City 6, N. J.
Mention L-515 on card

Shielding Rooms. New 8-page brochure illustrates and describes maker's multi-cell shielding rooms for r-f. interference suppression. Includes typical applications, designs available, attenuation characteristics, and features.—Shielding, Inc., Riverside Park, N. J.
Mention L-516 on card

Electronic Equipment. New 4-page issue Vol. 9, No. 1 of "Allied Radio and Electronic News" features article

on modulated waves. Also articles on experimental transistor equipment and "Micropots" potentiometers.—Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Mention L-517 on card

Comparison Bridge. New 4-page bulletin illustrates and describes maker's "Model E-1" comparison bridge for production-line checking of resistors, capacitors, and inductances with standard units, indicating percentage deviation directly. Includes applications, electrical and mechanical specifications.—Southwestern Industrial Electronics Co., Inc., 2831 Post Oak Road, P O Box 13058, Houston 19, Texas.
Mention L-518 on card

Electronic Maintenance. New 24-page issue of "Successful Servicing" features article "The Cosine Yoke" on deflection yokes for TV receivers. Also articles on printed electronic circuits, and replacement parts in TV receivers.—John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y.
Mention L-519 on card

Millivoltmeter Type Instruments. New 20-page Catalog 1053 describes and illustrates Brown millivoltmeter type instruments; indicators, indicating electronic controllers, and excess temperature safety cut-off controllers. Includes information on operation and application of on-off, two-position, three-position, and "pulse type" time-proportioning controllers. Also primary measuring elements, dimensions, and scale selecting tables.—Station 64, Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.
Mention L-520 on card

Carrier Systems. New 12-page issue of "The Lenkurt Demodulator," Vol. 2, No. 3, illustrates and describes basic principles of maker's "Compandors" and their application to carrier systems. For use in carrier telephone channels to provide an effective improvement in signal-to-noise ratio. Includes development, use, control range, operation, and benefits.—Lenkurt Electric Sales Co., San Carlos, Calif.
Mention L-521 on card

Telemetering. New 38-page Booklet M1710, illustrates and describes maker's Metameter telemeter for remote measurement and automatic control of variables over distances ranging from a few feet to many miles. Includes installations and applications.—The Bristol Co., Waterbury 20, Conn.
Mention L-522 on card

Computing, Counting

Photoformer Data Processors. New 2-page bulletin describes principles and uses of Photoformer cathode-ray-tube-type data processors and function generators in fields of analog computation, flight control, automatic process control, and others.—Benson-Lehner Corp., 2340 Sawtelle Blvd., Los Angeles 64, Calif.
Mention L-523 on card

IF your requirments call for a small, powerful, synchronous, motor

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48 in. oz. starting torque at 1 RPM.
40 in. oz. synchronous torque at 1 RPM.
Voltages up to 550 (without resistors or accessories.)
Frequencies 25 to 60 cycles.
Interchangable coils for different voltages.
Exposed coil for greater heat radiation.
Rigid metal gear case.
Available in reversible type motor.

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a non-shrinking casting metal that melts at 117 F.

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3. **Supporting or nesting delicate parts, preventing distortion or shifting during grinding, milling or other machining operations. Turbine buckets, compressor blades and vanes held in this alloy, after accurate positioning, are ground to very close tolerances.**
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Buffalo 21, New York

Manufacturer's New Literature

"GraphAnalogue." New bulletin describes and illustrates maker's new "Graphanalogue" with variable scales for reading oscillograms with nonlinear calibration, data reduction, etc. Includes applications and 32-page instruction manual on maker's variable scale.—Gerber Scientific Instrument Co., 162 State St., Hartford 3, Conn.
Mention L-524 on card

Square-root Planimeter. New 2-page engineering data sheet describes and illustrates maker's square-root planimeter which provides flow chart totalizing of graphic panel strip-chart recorders.—Librascope Inc., 1607 Flower St., Glendale, Calif.
Mention L-525 on card

Gear Wire Formula. New Catalog 53 describes new type gear wire mathematical formula which makes possible the figuring of correct wire sizes for both spur and helical gears with the one formula.—Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.
Mention L-526 on card

Desiccant Calculator. New release illustrates and describes maker's desiccant calculator for quick indication of how many desiccant units are required per package in accordance with MIL-P-116A.—Greenwood Packaging Supply Co., 859-879 Summer Ave., Newark 4, N. J.
Mention L-527 on card

Speed, Timing

Tachometer. New 20-page illustrated Bulletin S1402 describes maker's tachometers for measuring rotational speed, speed of travel, time in process, ratio of two speeds, sum or average of speeds, and difference between speeds. Includes applications, charts and ranges, specifications and dimensions.—The Bristol Co., Waterbury 20, Conn.
Mention L-528 on card

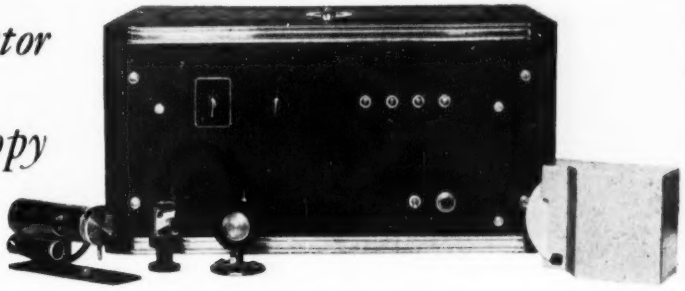
Repeat Cycle Timer. New 2-page bulletin describes and illustrates maker's repeat cycle timer for control of machinery cycles. Includes characteristics, technical data, and ordering information.—G. C. Wilson & Co., 2 N. Passaic Ave., Chatham, N. J.
Mention L-529 on card

Hubodometer. New bulletin illustrates and describes maker's "Pe-Ka" driveless hubodometer providing for tire mileage, chartered trips, preventative maintenance, mileage of equipment, etc.—Engler Instrument Co., 250 Culver Ave., Jersey City 5, N. J.
Mention L-530 on card

Hour Log. New bulletin illustrates and describes new "Pe-Ka" hour log for trucks, tractors, generators, etc., which registers hours of engine operation.—Engler Instrument Co., 250 Culver Ave., Jersey City 5, N. J.
Mention L-531 on card

A Superior Detector
for
Infra-Red Spectroscopy

GOLAY PNEUMATIC DETECTOR



Among the characteristics that render the Golay Detector superior to other types of detectors for use in infrared spectroscopy are:

1. **An effective sensitive area 3/32" in diameter.**
2. **Sensitivity of 6 x 10^{-11} watts RMSENI when used with "chopped beam" method and with recording time constant of 1.6 second.**
3. **Uniform sensitivity from the ultra-violet through the visible and the entire infra-red, and up to the micro-wave region.**
4. **Improved, drift-free, A.C. operated amplifier with step gain controls and four response periods.**

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THE EPPLEY LABORATORY, INC.

SCIENTIFIC INSTRUMENTS

2 SHEFFIELD AVENUE, NEWPORT, RHODE ISLAND, U.S.A.

Elapsed Time Controllers. New 4-page Technical Information Sheet TI-33-A-68a illustrates and describes maker's "Model 40E" elapsed time controller for batch or repetitive single-operation processes. Includes operation, specifications, and designs. —The Foxboro Co., Foxboro, Mass.

Mention L-532 on card

Driving Gage. New 2-page Bulletin 693-134 illustrates and describes maker's driving gage that indicates engine economy when connected to vacuum created at intake manifold of any automotive-type gas engine. Includes installation, design, uses.—Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.

Mention L-533 on card

Synchronous Brake. New 4-page brochure illustrates and describes maker's synchronous brake for governing speed of a rotating device. Includes construction, electrical characteristics, calculation of brake capacity, and some methods of use.—Allard Instrument Corp., 30 Broad St., New York 4, N. Y.

Mention L-534 on card

Weight

Electronic Crane Scale. New bulletin illustrates and describes new "Ametron" electronic crane scale for use in factories, mines, and railway yards. Includes installation, operating procedures, and features.—Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

Mention L-535 on card

Recording

Graphic Instruments. New 16-page booklet 'Case 42' illustrates and describes manifold uses of graphic instruments throughout industry.—The Esterline-Angus Co., Inc., Indianapolis, Ind.

Mention L-536 on card

Tape Recording Equipment. New 4-page illustrated Catalog A101 presents detailed specifications and prices on complete line of "Ampex" recording equipment and audio accessories for up to 8 hours continuous play with automatic reversal.—Audio & Video Products Corp., 730 Fifth Ave., New York 19, N. Y.

Mention L-537 on card

Testing & Inspection

Miniature Vibration Pickup. New 4-page bulletin illustrates and describes maker's "Type 4-118" miniature velocity pickup for use in research and engineering phases of product development and for quality control and testing. Includes suggested circuits.—Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Mention L-538 on card

Optical Tooling. New 4-page brochure illustrates and describes maker's "Align-A-Scope" for accurately locating positions of fixtures on a jig frame which acts as guides in precision manufacturing. Includes accessories and specifications.—Align-A-Scope, Inc., 2123 Stoner Ave., W. Los Angeles 25, Calif.

Mention L-539 on card

Dynamic Balancer. New 4-page brochure illustrates and describes maker's "Micro-Namic" sensitive dynamic balancer that detects unbalance vibration as small as 0.0000002 inch, locates angular position of unbalanced mass by direct-reading dials, and corrects unbalance by precision metered drilling to alter mass by as little as 0.0000045 ounce.—Micro Balancing Inc., Herricks Road, Garden City Park, N. Y.

Mention L-540 on card

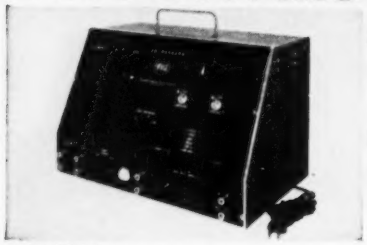
Gaging Equipment. New Bulletin 531 illustrates and describes maker's special gaging equipment for recording deviations from diameter in millionths along full length of work. Designed for production inspection of straight cylindrical pins whose diameter must be checked at four points to plus or minus 0.000005.—Cleveland Instrument Co., 735 Carnegie Ave., Cleveland 15, Ohio.

Mention L-541 on card

Dynamic Balancer. New 4-page bulletin presents "hints and diversions" to help solve problems in dynamic balancing, coil winding, armature winding, and slot insulation. Features maker's "Model NEH-190" super-sensitive dynamic balancer with auxiliary "NE-136" heads. Includes principles of balancing.—The Globe Tool and Engineering Co., 430 Davis Ave., Dayton 3, Ohio.

Mention L-542 on card

G·R·S SYNCROGRAPH



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HI-SPEED
TIMING
0.0001 to 9.99
SECONDS
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Voltage and current changes
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Readily operated by unskilled help
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PORTABLE
COMPACT

Weight-26 lbs.
13" x 11" x 9" high

Built-in power supply and input switching

Carrying case, set of test leads, and complete instructions included

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SPECIFICATIONS

Ranges and Accuracy: 0-99.9, 0-999, 0-9990 milliseconds, ±1%

Start and Stop: Independent start and stop on make, break, +pulse, −pulse. Sensitivity control on pulse inputs.

Cumulative Timing: Total time of one or more intervals external circuit is closed, or varying input exceeds 5 volts.

Input Resistance: 2.2 megohms.

Display: Direct digital. Switch selection of single readings or accumulated total.

Electronic Counter: 10,000 counts/sec. max. Jack for external pulse input.

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NEW YORK 17 CHICAGO 3 ROCHESTER 3, N. Y. ST. LOUIS 1

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IMMERSION
Thermocouple
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MOLTEN METAL
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Tested in the Open Hearths for months under trying conditions, STAMCO is:

LIGHT WEIGHT — just 26 lbs., including 25' of wire

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ECONOMICAL — longer life, lower cost per reading

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Manufacturer's New Literature

Surface Flatness. New 6-page Bulletin L-404 illustrates and describes maker's method of measuring surface flatness through light-band reading. Interpretation of readings is explained. Includes instructions on care and operation of monochromatic lights and optical flats.—Crane Packing Co., 1800 Cuyler Ave., Chicago 13, Ill.
Mention L-543 on card

Roughness Comparison Specimens. New 2-page bulletin illustrates and describes maker's roughness comparison specimens for accurate means of determining smoothness or roughness of a machined surface. Includes table of group combinations for types of surfaces.—Acme Industrial Co., 200 N. Laflin St., Chicago 7, Ill.
Mention L-544 on card

Vibration Test Equipment. New 4-page illustrated Bulletin 1453 describes maker's vibration test equipment accelerometer calibration systems, intermediate shaker systems, 2500-pound shaker systems, accelerometers, and associated equipment.—The Calidyne Co., Winchester, Mass.
Mention L-545 on card

Dial Indicator. New 4-page bulletin illustrates and describes maker's new "Pearson" dial indicator for industrial use. Includes parts, price list.—M & G Instrument Co., 12940 Saticoy St., North Hollywood, Calif.
Mention L-546 on card

Electronic Inspection, Safety. New 16-page Bulletin 1252 illustrates and describes maker's electric-eye methods for supervision of automatic production, operations, packaging, sorting, inspecting, rejection, lighting, and safety.—Worner Electronic Devices, Rankin, Ill.
Mention L-547 on card

Fineness-of-grind Gages. New 4-page Bulletin 114 illustrates and describes maker's fineness-of-grind gages for paints and related products. Includes features, specifications, and use instructions.—Gardner Laboratory Inc., Bethesda, Md.
Mention L-548 on card

Impact Tester. New bulletin illustrates and describes maker's 80-inch-pound range variable impact-tester for paints, varnishes, lacquers and other coating materials. Includes specifications and procedure.—Gardner Laboratory Inc., Bethesda 14, Md.
Mention L-549 on card

Testing Apparatus. New 4-page Bulletin 17 announces that Soiltest, Inc. has assumed activities formerly carried on by Soil Testing Services, Inc. Includes descriptions of physical testing apparatus for soils, bituminous materials, and concrete.—Soiltest Inc., 4522 W. North Ave., Chicago 39, Ill.
Mention L-550 on card

Porosity Detector. New 8-page brochure describes maker's new "Type PR" porosity detector for detecting and recording holes in material which is electrically non-conducting by use of adjustable voltage between 500 and 5000 volts. Tests material up to forty thousandths of an inch thick.—Viking Instruments, Inc., East Haddam, Conn.
Mention L-551 on card

Rate-of-turn Table. New 6-pages of temporary data sheets present features, components, operation, test results, cost, installation, and maintenance of maker's rate-of-turn table with continuously variable range from 0.010 deg./sec. to 1200 deg./sec.—Genisco, Inc., 2233 Federal Ave., Los Angeles 64, Calif.
Mention L-552 on card

Air

Air Cleaner, Dryer. New 2-page brochure illustrates and describes maker's "Model B-30-D Condensifilter" which makes air of "instrument quality" from ordinary plant air by dehydrating and filtering. Includes components and specifications.—Hankinson Corp., 951 Banksville Rd., Pittsburgh 16, Pa.
Mention L-553 on card

Air Cleaner, Dryer. New Bulletin 1150 illustrates and describes new "Aridifier" for cleaning and drying compressed air. Includes capacities, requirements, and dimensions.—Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill.
Mention L-554 on card

Valves

Diaphragm-motor Valve. New 2-page Supplement Five Catalog 70 illustrates and describes maker's porcelain "Valvrator" diaphragm air motor valve for corrosive surfaces and bubble-tight shut-off. Installation procedure included.—Fischer and Porter Co., Hatboro, Pa.
Mention L-555 on card

Valves. New 16-page Catalog 801 covers a series of newly designed anhydrous ammonia valves and steel fittings for use where ammonia and other gases, non-corrosive to steel, are used. Includes angle valves, relief valves, tee valves, vapor-return valves, etc.—Henry Valve Co., 3215 North Ave., Melrose Park, Ill.
Mention L-556 on card

Solenoid Valves. New 80-page Valve Catalog 24 illustrates and describes maker's line of solenoid valves. New additions are; two-way midget valves with time-delay feature, explosion-proof valves, three way midget valves, and many others. Includes operating characteristics, specifications, applications, and class of valves.—Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.
Mention L-557 on card

Gate Valve. New 4-page Bulletin 535 illustrates and describes maker's gate valve with new all-welded aluminum body construction with pressure-balanced floating seal. Includes features, specifications and engineering data.—The Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.
Mention L-558 on card

Electrical & Electronic Components

Germanium Diodes. New 4-page bulletin illustrates and describes maker's germanium diodes, selenium diodes, diode kits and molded rectifiers.—International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.
Mention L-559 on card

Hermetically Sealed Resistor. New 6-page brochure illustrates and describes maker's new "CE" hermetically sealed resistor being manufactured in 45 different sizes and types.—Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.
Mention L-560 on card

Controllable Inductor. New 6-page Bulletin 65BA1 illustrates and describes maker's "Increductor" controllable inductor for wide-range frequency shift. Includes designs, characteristics, and specifications.—C.G.S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
Mention L-561 on card

Magnetic Amplifiers. New bulletin describes and illustrates maker's standard packaged push-pull magnetic amplifiers, saturable transformers, tubeless servo amplifiers, and magnetic servo amplifiers.—Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
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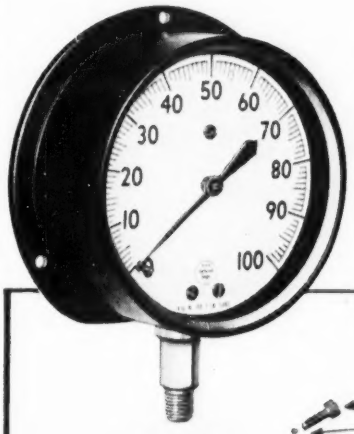
an ACCO product

HELICOID Chemical Gage

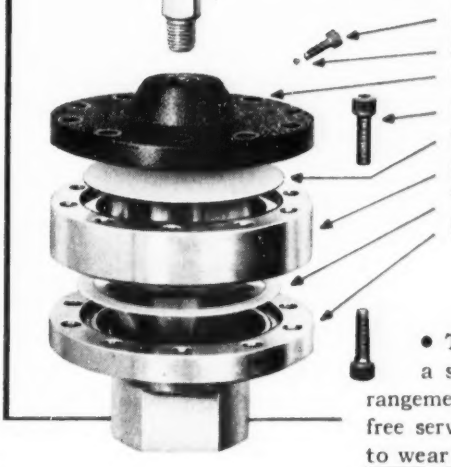
The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year



• For chemicals and liquids which would corrode or clog the Bourdon tube. Simple, sturdy construction proved in the field.

Pressures to 3000 p.s.i., vacuum, or compound; temperatures to 400° F. Diaphragm unit may be ordered separately.

FEATURES



• The Helicoid movement is a simple cam and roller arrangement that gives long, trouble-free service. It has no gear teeth to wear out. Helicoid Gages are made in various sizes and shapes, with black, white, or phosphorescent dials. For wall or stem mounting. Helicoid Gages cost less in the long run.

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Write today for the Helicoid catalog

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HELICOID Pressure • Vacuum GAGES

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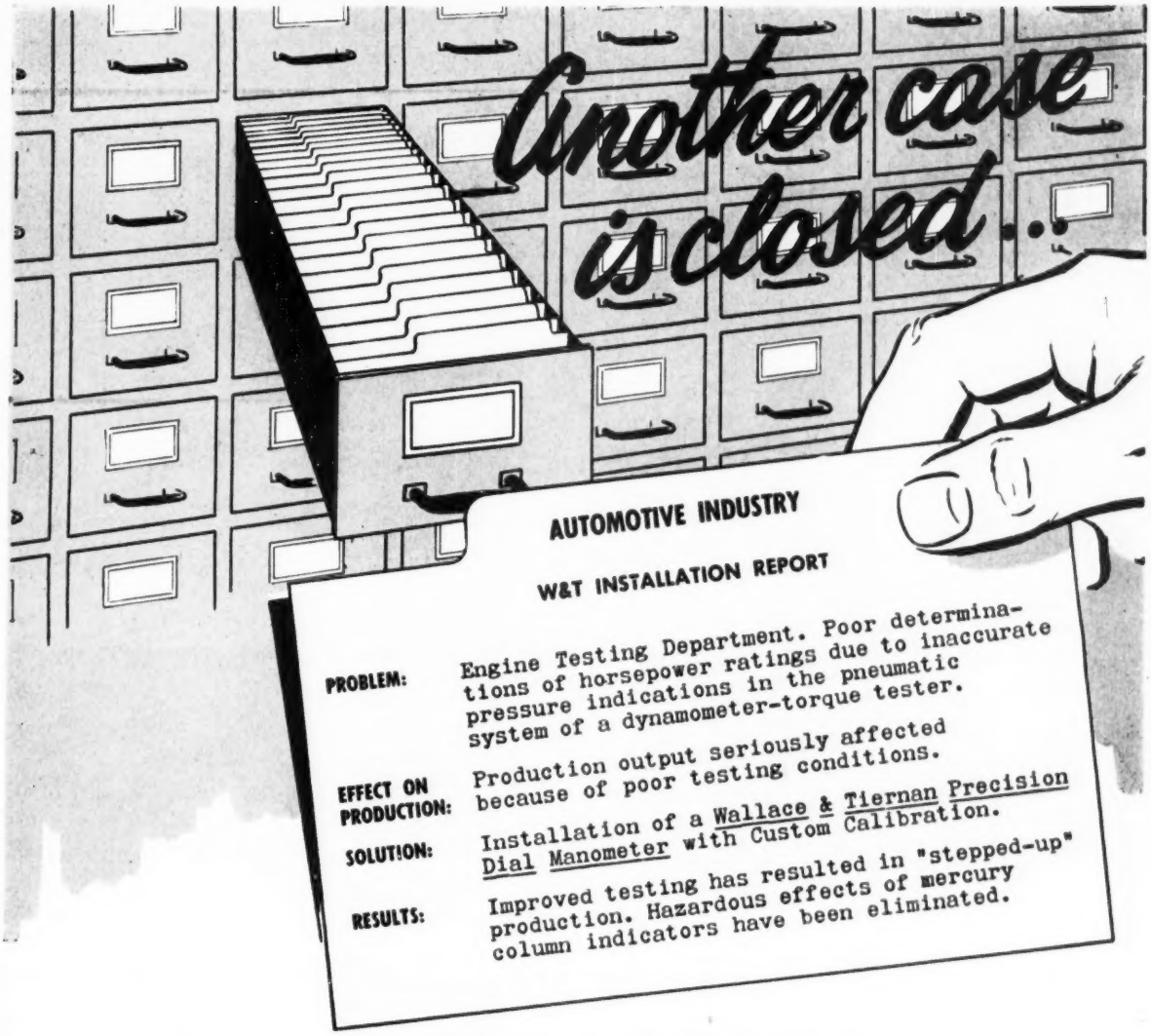
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W&T INSTALLATION REPORT
PROBLEM: Engine Testing Department. Poor determinations of horsepower ratings due to inaccurate pressure indications in the pneumatic system of a dynamometer-torque tester.
EFFECT ON PRODUCTION: Production output seriously affected because of poor testing conditions.
SOLUTION: Installation of a Wallace & Tiernan Precision Dial Manometer with Custom Calibration.
RESULTS: Improved testing has resulted in "stepped-up" production. Hazardous effects of mercury column indicators have been eliminated.

...Thanks to a W&T Precision Instrument

W&T Precision Dial Manometer

FEATURES:

Full protection against overpressure
Custom calibrated scales in units of force or torque
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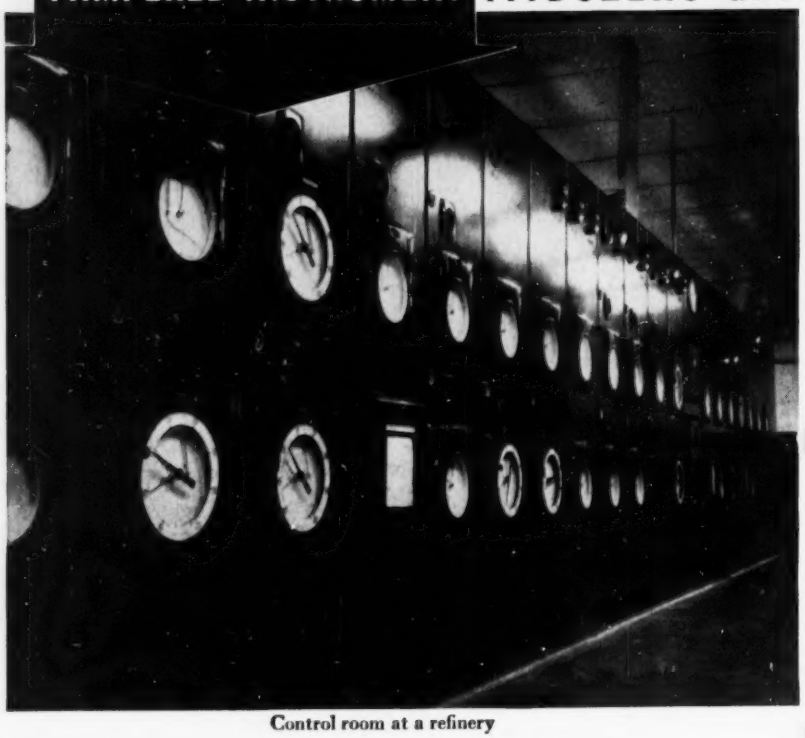
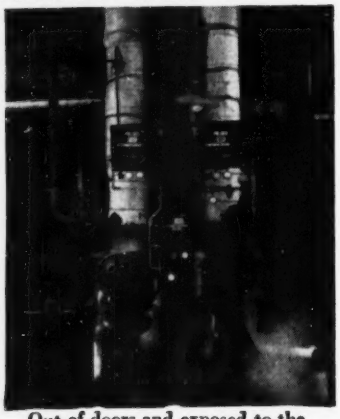
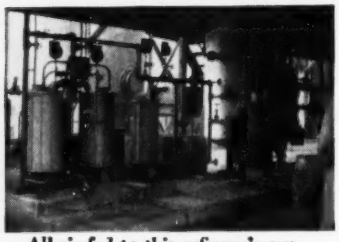


Control room at a refinery



Out-of-doors and exposed to the elements, but dependability is a prime requirement here.



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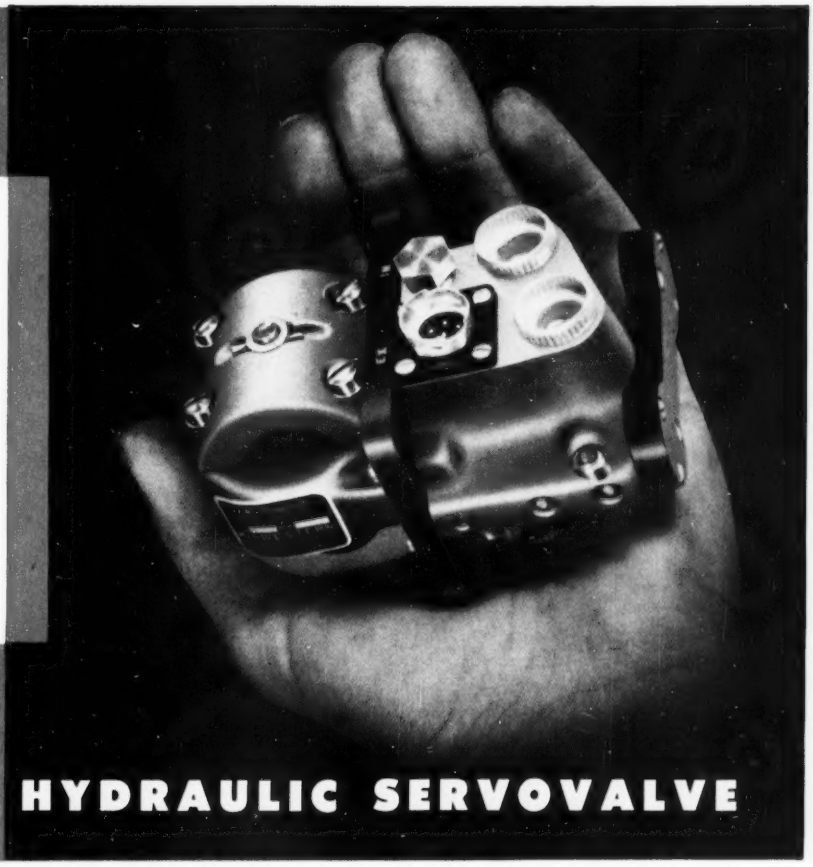

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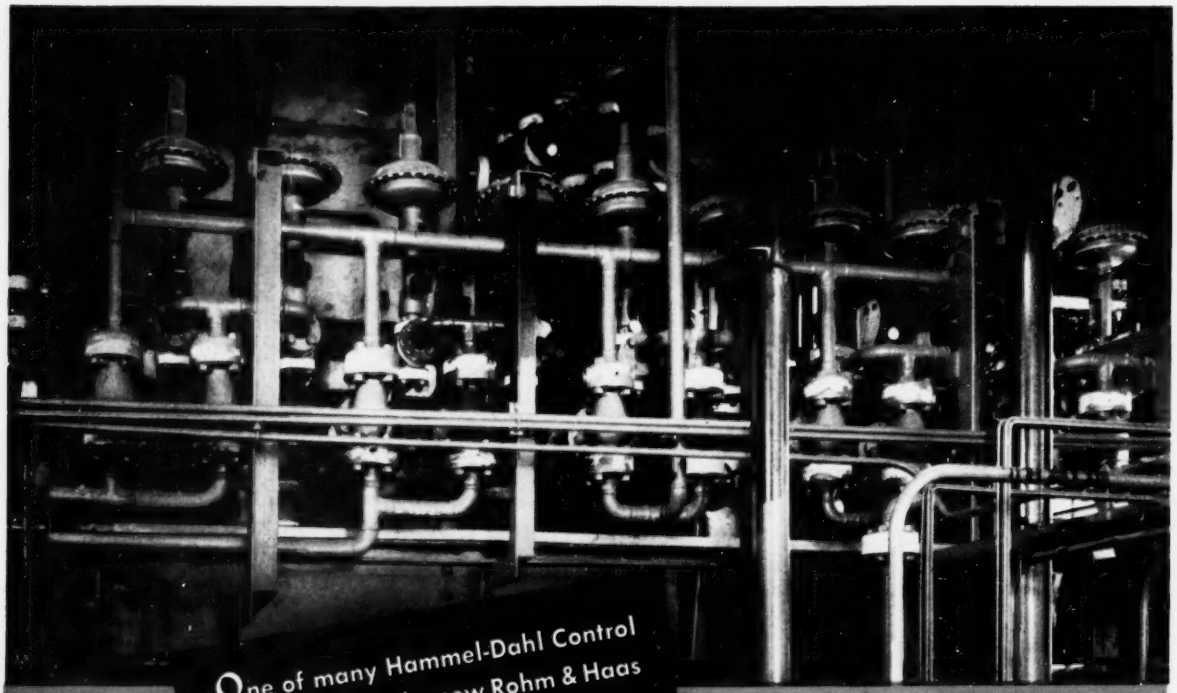

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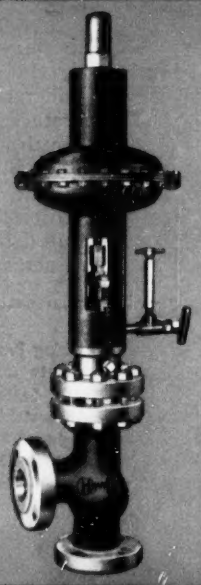

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